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TECHNOLOGY REVIEW

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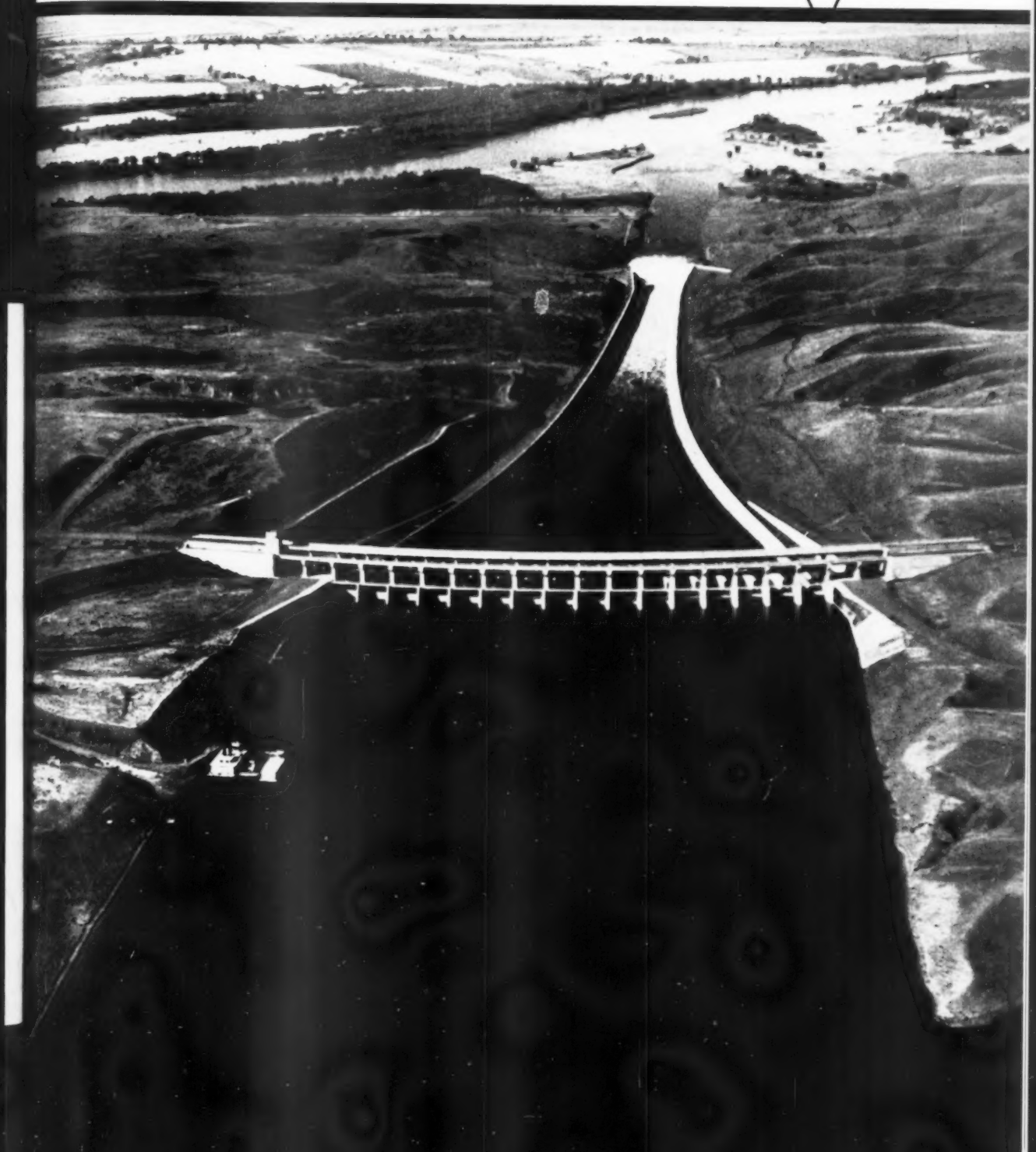

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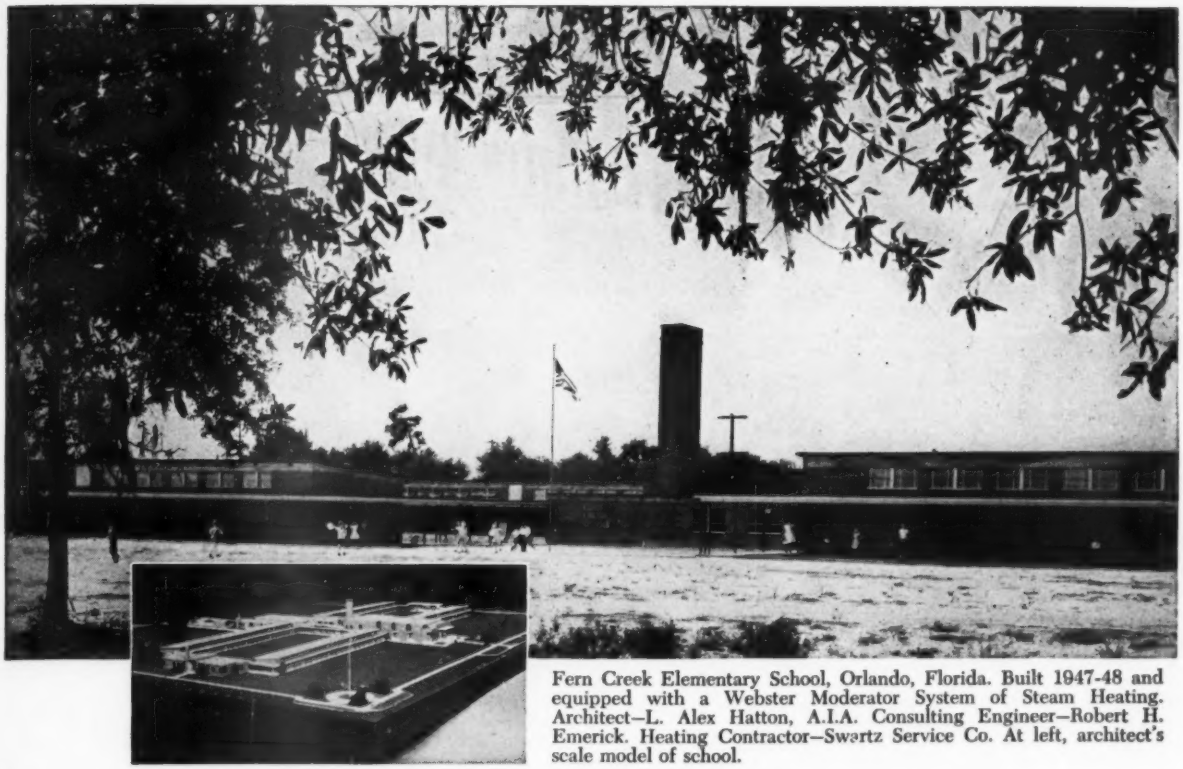

Fern Creek Elementary School, Orlando, Florida. Built 1947-48 and equipped with a Webster Moderator System of Steam Heating. Architect—L. Alex Hatton, A.I.A. Consulting Engineer—Robert H. Emerick. Heating Contractor—Swartz Service Co. At left, architect's scale model of school.

"...lots nicer than a big old school"

The Orlando (Fla.) Sentinel-Star recently asked a group of 9, 10 and 11-year-olds what they thought of Orlando's newest and most modern school.

A 10-year-old acted as spokesman. "It's wonderful," he said. "We think it's lots nicer than a big, old school."

The Fern Creek Elementary School is a source of pride to students, teachers and parents alike. Every detail in its construction is the last word in school planning.

...and it's heated by Webster Moderator System

Heating of the school is by low pressure steam from a central boiler room. A Webster Moderator System of Steam Heating provides the temperatures desired automatically, with every change in outdoor weather. Prefabricated Webster System Radiators are recessed in classroom walls. Webster-Nesbitt Unit Heaters are used in the cafeteria.

Although construction is the basementless type, piping is concealed. A ventilating system replaces the air in each classroom at the rate of 6,000 cubic feet per minute.

Features of the ultra-modern Fern Creek School include: gaily painted classroom interiors, audio-visual aids, bathroom facilities for each classroom in the first three grades, soundproofed ceilings. Each classroom opens on one side directly onto the 8-acre campus and on the other to a covered walkway which is accessible to any other part of the school.

Find out why modern steam heating under Webster Moderator Control is the first choice of leading school architects, consulting engineers and heating contractors. A Webster Representative will gladly furnish full details.

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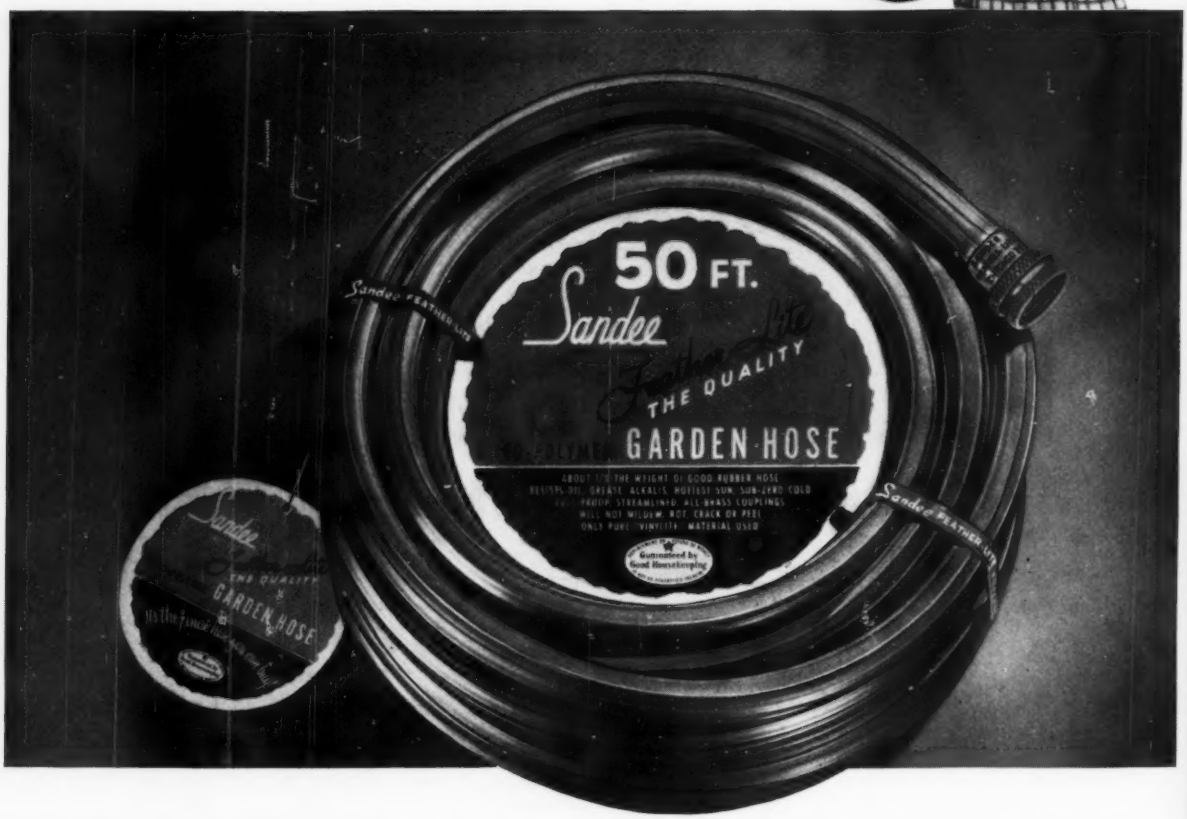

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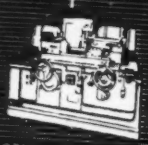
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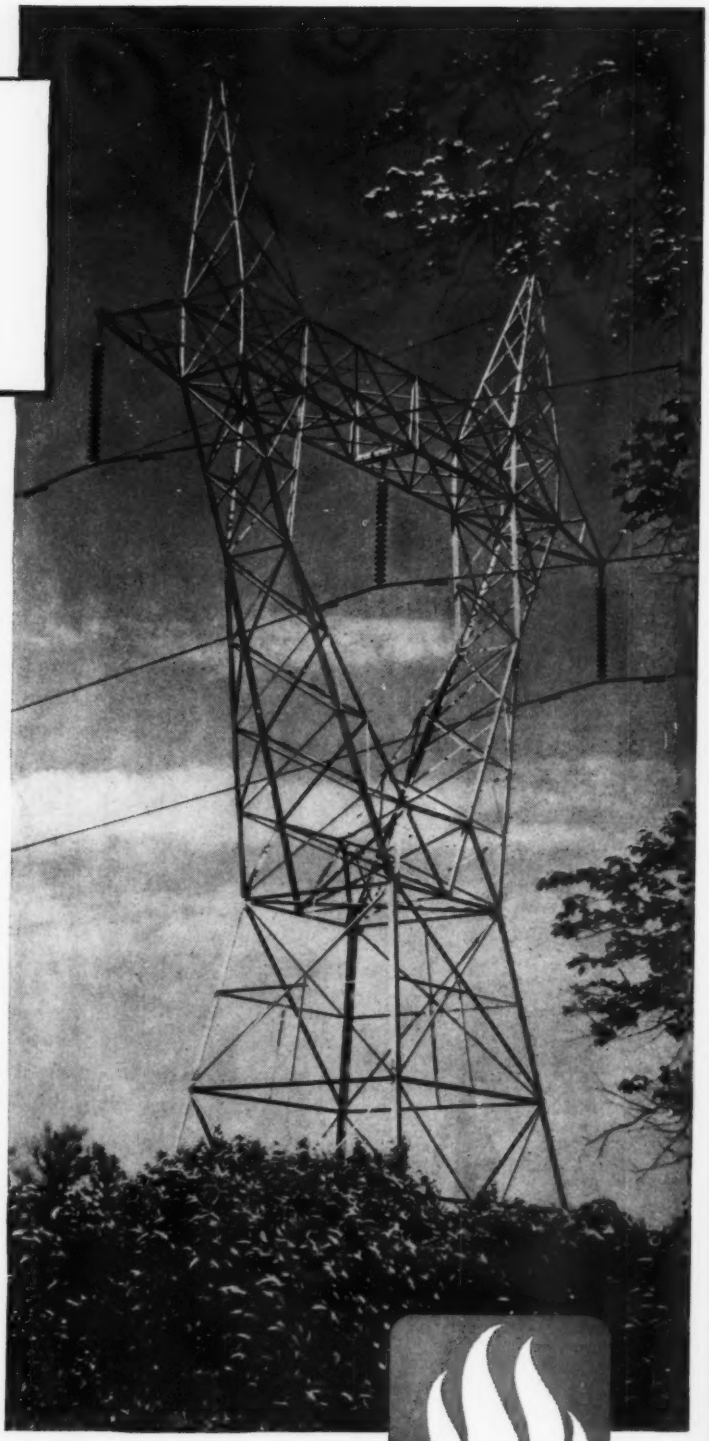
New Power for America



Lights will not go out in America, nor will productive machines stand idle for lack of power, if the nation's electric utilities can help it. And they began to plan this help a decade ago through an expansion program — interrupted by the war — that is now well on the way to being realized.

In 1947 privately owned utilities expended over 60 per cent more for new steam power capacity than in the previous all-time peak year (1924). 1948 expenditures were nearly double 1947 and 1949 will substantially exceed 1948.

In the four-year period, 1946 through 1949, the total capital expenditures by private utilities for expansion of electric service to the homes and industries of America will have exceeded 6½ billion dollars.

It is equally significant that, in a time of skyrocketing costs, the electric utilities have represented the last stand of the 100-cent dollar, maintaining the price of their product at a level long since passed in all other fields.

So there should be little wonder, and no resentment, that current conditions compel a needed — and tardy — increase in public utility rates. Even with this essential relief, purchased light and power will continue to be *America's best buy*.

This unique situation is due in large measure to technological improvements during the last quarter century — improvements to which Combustion Engineering made such important contributions as the pioneering of pulverized coal firing, water-cooled furnaces, and new and better designs of steam generating equipment and methods of firing. This experience in developing ever more economical steam generating equipment for utility power stations is reflected in the extensive C-E line available for *all* users of steam. B-284

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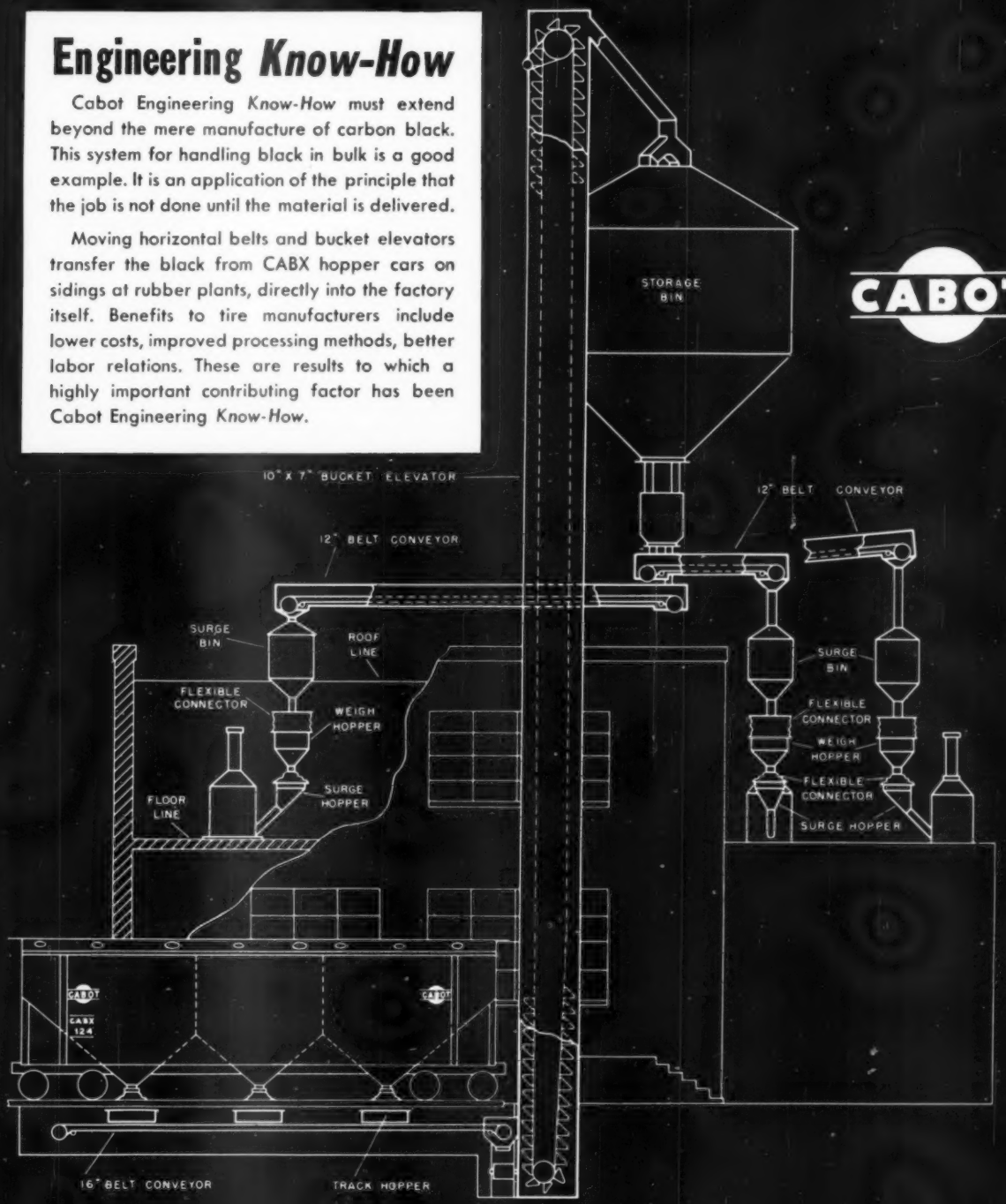
Engineering *Know-How*

Cabot Engineering *Know-How* must extend beyond the mere manufacture of carbon black. This system for handling black in bulk is a good example. It is an application of the principle that the job is not done until the material is delivered.

Moving horizontal belts and bucket elevators transfer the black from CABX hopper cars on sidings at rubber plants, directly into the factory itself. Benefits to tire manufacturers include lower costs, improved processing methods, better labor relations. These are results to which a highly important contributing factor has been Cabot Engineering *Know-How*.

CABOT



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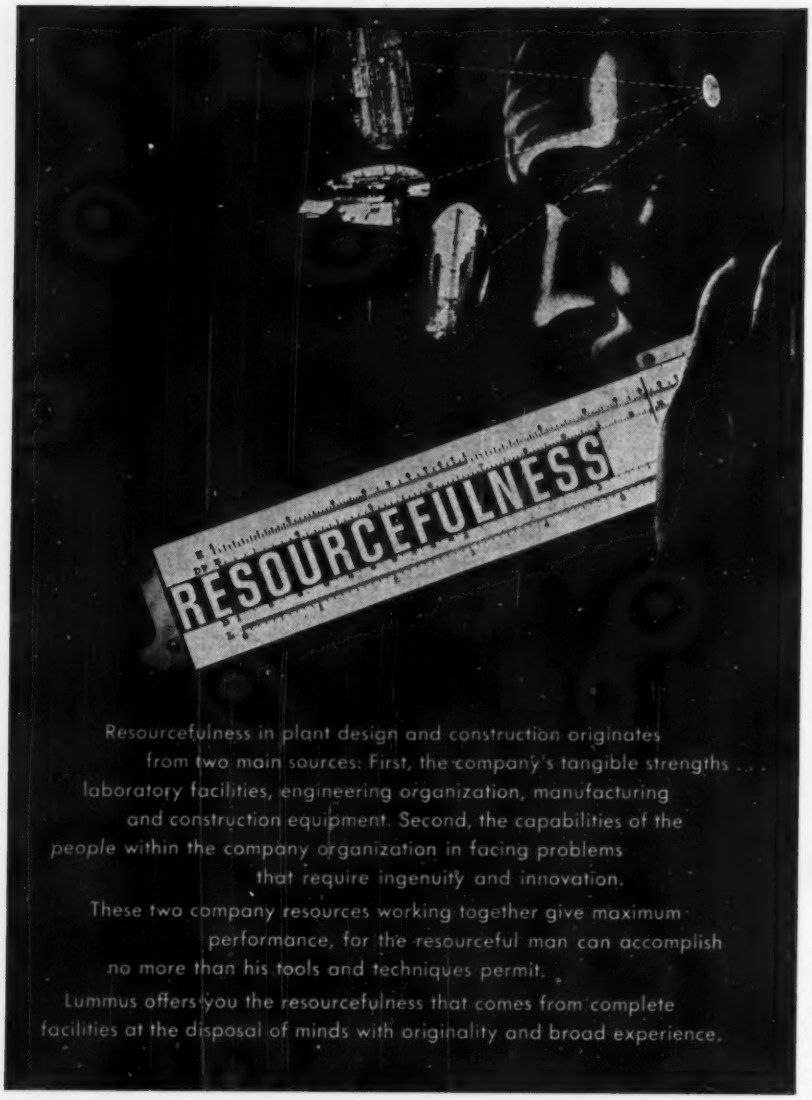

Resourcefulness in plant design and construction originates from two main sources: First, the company's tangible strengths . . . laboratory facilities, engineering organization, manufacturing and construction equipment. Second, the capabilities of the *people* within the company organization in facing problems that require ingenuity and innovation.

These two company resources working together give maximum performance, for the resourceful man can accomplish no more than his tools and techniques permit.

Lummus offers you the resourcefulness that comes from complete facilities at the disposal of minds with originality and broad experience.

RESOURCEFULNESS
in construction

Completion of this essential wartime plant faced a seemingly "unavoidable" delay:—the nation's entire shop capacity for tower and tank construction was already fully booked for equally essential work. Lummus met the emergency by building a complete pressure vessel shop on the site. Here, using modern time-saving methods such as automatic welding, towers and tanks for this and other vital war plants were fabricated on schedule.

RESOURCEFULNESS
in planning

The problem here was to boost the capacity of a 10,000 B/D topping unit to 25,000 B/D without a serious break in output. By ingenious advance planning, the change-over was made with *only 72 hours downtime*. Nor was it just a "lucky accident"—for Lummus had assumed responsibility in its contract for this 72-hour time limit.

RESOURCEFULNESS
in training

To erect this plant in an isolated foreign location, local native labor was the only practical labor supply. Yet most of these people had never held a tool or even seen a welding torch. Lummus sent supervisors and foremen picked for their training aptitudes, backed them up with modern visual-education methods, organized a training school. "Graduates" were ready to meet erection schedules. Quality of workmanship met every test.

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Now . . . for the first time . . . you can install electric motors, or motor-driven machines . . . and forget motor lubrication.

Westinghouse Life-Line . . . industry's amazing, new, all-steel motor . . . now completely eliminates need for lubrication. Life-Line motors are equipped with sealed bearings, pre-lubricated with a more-than-ample supply of specially treated lubricant. Correct lubrication is assured . . . machine outages are reduced . . . motor-drive problems are simplified, since motors can be located without need for constant accessibility.

Added to Life-Line's plate-steel protection, improved windings and more compact size, *pre-lubrication* is one more important reason for starting to convert, today, to Life-Line power. Standard ratings available from stock—others on short delivery. Ask your Westinghouse representative for prices and delivery on your requirements, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

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No. 2 UNIVERSAL MILLING MACHINE
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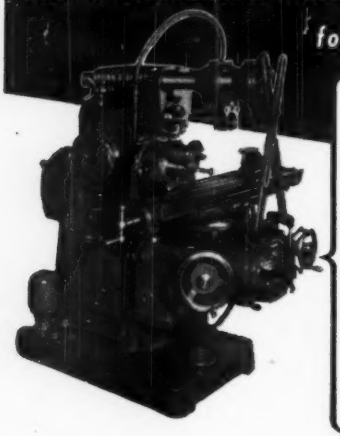

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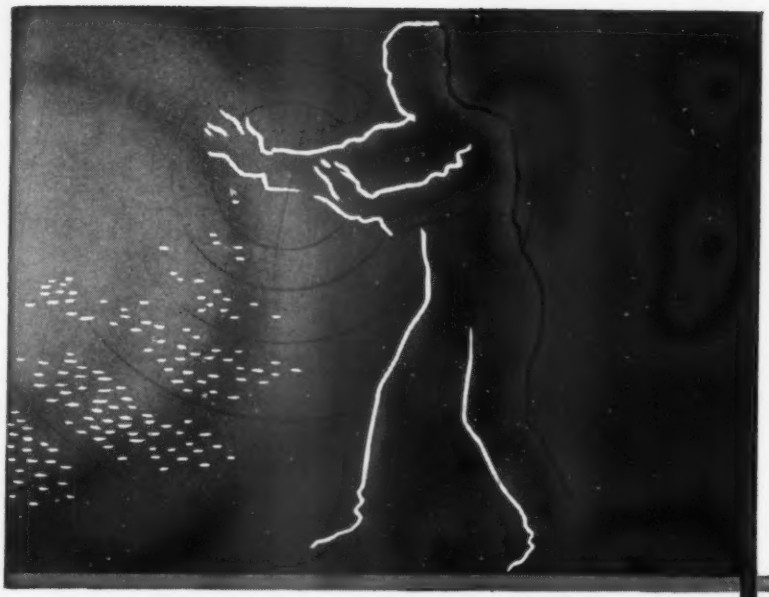
THE TABULAR VIEW

Flight Progress. – In examining half a century of mechanical flight since the Wright brothers made their first successful sky ride at Kitty Hawk, S. PAUL JOHNSTON, '21, discerns (page 500) three clearly marked avenues of activity which have made possible today's modern aircraft; the invention of the airplane itself, research on air flow, and the great strides which have been made in increasing the efficiency and power output of airplane power plants. Since his graduation from the Institute, Mr. Johnston has been continuously identified with the aviation industry. He has served as editor of *Aviation*, co-ordinator of research for the National Advisory Committee for Aeronautics, research director for the Curtiss-Wright Corporation, deputy director of the aircraft division of the United States Strategic Bombing Survey, and since the end of World War II has been director of the Institute of the Aeronautical Sciences, Inc.

That's Wright! – Amplifying that phase of American aviation which, almost a half century ago, is centered about the first successful flights in heavier-than-air machines, is the story (page 504) on the human traits and characteristics of the Wright brothers. Whatever these two brothers may seem to others, FRED C. KELLY, who knew both men intimately, regards them as quiet, kindly, homespun men with a keen sense of humor and an insatiable curiosity about those factors which first made flying possible, and then more reliable. Beginning his career as a newspaper correspondent, Mr. Kelly has traveled extensively, has operated a 600-acre farm, and has managed to do a considerable amount of writing throughout the years. He is author of nine volumes, including one on *The Wright Brothers*.

The Forgotten Man. – With "capitalists" able to take care of their own interests (before taxes, at any rate) and benevolent and protective agencies looking after the welfare of "labor," the great segment of white-collar workers has been left to shift for itself. Indeed, from many points of view this portion of the nation's laboring force is truly symbolic of forgotten men. Their case is reviewed (page 508) by PAUL MEADOWS, Associate Professor of Sociology at the University of Nebraska, whose keen interest in social movements and the human aspects of modern industrialism, enables him to prepare, with authority, his most recent Review article.

Centennial Exposition. – When this nation was celebrating its centennial as a separate political unit, in 1876, faith and confidence in the future ran high. Vast areas of the West still remained to be developed and the country was regarded as having almost limitless resources. How the U.S. International Exposition of 1876 reflected its era is recorded (page 511) by E. H. CAMERON, '13, in the first installment of a two-part article. Head of the Technical Publications Division of Jackson and Moreland, Mr. Cameron has taken the study of engineering in the post-Civil War period as his avocation.



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Blind man's buff is an expensive game to play with alloy steels. It is safer to go directly to the steel that will give the best performance at the lowest cost per finished part.

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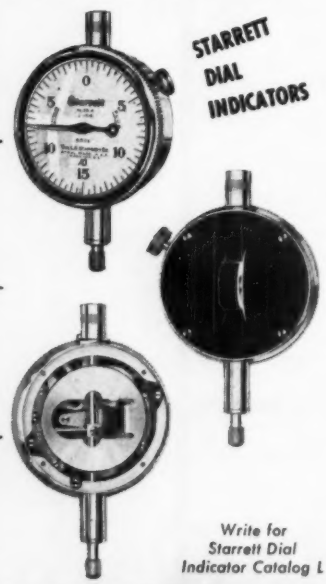

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MAIL RETURNS

Sound Effects

FROM ROBERT SIBLEY:

I certainly got a thrill out of that issue of The Review for March which you sent me. In the first place, I got the blind staggers when I looked at that beautiful picture of the Golden Gate Bridge, the pride of California. The photograph is excellent, and I think forwards the thing you and I would like to see, namely, a fuller and higher appreciation of engineering achievement throughout this nation.

Concerning the article "Architectural Acoustics" by yourself and A. M. Clarke, I was very much interested. It is one of the sad things about American architectural design that . . . acoustics is so often overlooked.
Berkeley, Calif.

[*The Review presents the above letter from Mr Sibley of the University of California Alumni Association which was addressed to Richard H. Bolt.* — Ed.]

No Nostalgia

FROM DONALD L. DOWLING, '20:

I am taking this means to add my congratulations to the committee who organized the M.I.T. Convocation.

I am sure that all the delegates were as proud to be M.I.T. graduates as I was, and to meet with such outstanding leaders of scientific, political, and philosophical thought.

I could not help but think that Technology is the place where you cannot talk about the good old days. Certainly M.I.T. has improved tremendously since I was graduated.
Ridgewood, N. J.

Scientific Safety

FROM WILLIAM SAMPLE, JR., '34:

I am very much surprised that a scientific magazine such as The Review would print in its February issue the article "The Price of Haste" which was based on very poor scientific study.

The certificated air lines of the United States are extremely cognizant of the fact that their very existence is based upon a safe operation and certainly would do nothing that was a compromise with safety.
San Diego 1, Calif.

Speed with Economy

Goodyear Tire & Rubber Co.

You can test a new machine before you buy it. You can't do this with a building. In this case you must test the builder. Whom has he built for? What is the caliber of his personnel? Has he a record for dependable service at reasonable cost?

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ALFRED T. GLASSETT, '20, *Vice President*

"—The first wealth is health" —RALPH WALDO EMERSON

. . . and oxygen wins another fight for life!

OXYGEN has saved many a fine baby like this. Born ahead of time, with lungs and heart slow to function, the dreaded blue color was appearing. But oxygen in an incubator won the fight!

From childbirth on through life, the use of oxygen in medical treatment is now becoming routine . . . far different from the emergency uses of earlier years.

An oxygen-enriched atmosphere makes breathing easier —reduces the strain on the overloaded heart and congested lungs. The result is less fatigue and exhaustion, and greater comfort and quicker recovery for the patient.

And in other situations, where heart action is impaired by shock or obstruction of a blood vessel, oxygen often brings vital relief. All modern hospitals have adequate equipment for oxygen therapy, often with oxygen piped to beds from a central supply.

The people of Union Carbide produce oxygen and many other materials that help all of us stay healthier, live longer. They also produce hundreds of other materials for the use of science and industry, to help maintain American leadership in meeting the needs of mankind.

FREE: *An informative "Oxygen Therapy Handbook" is available free of charge to doctors, nurses, and persons interested in hospital administration. If you would also like information on other products of Union Carbide ask for the free booklet "Products and Processes."*

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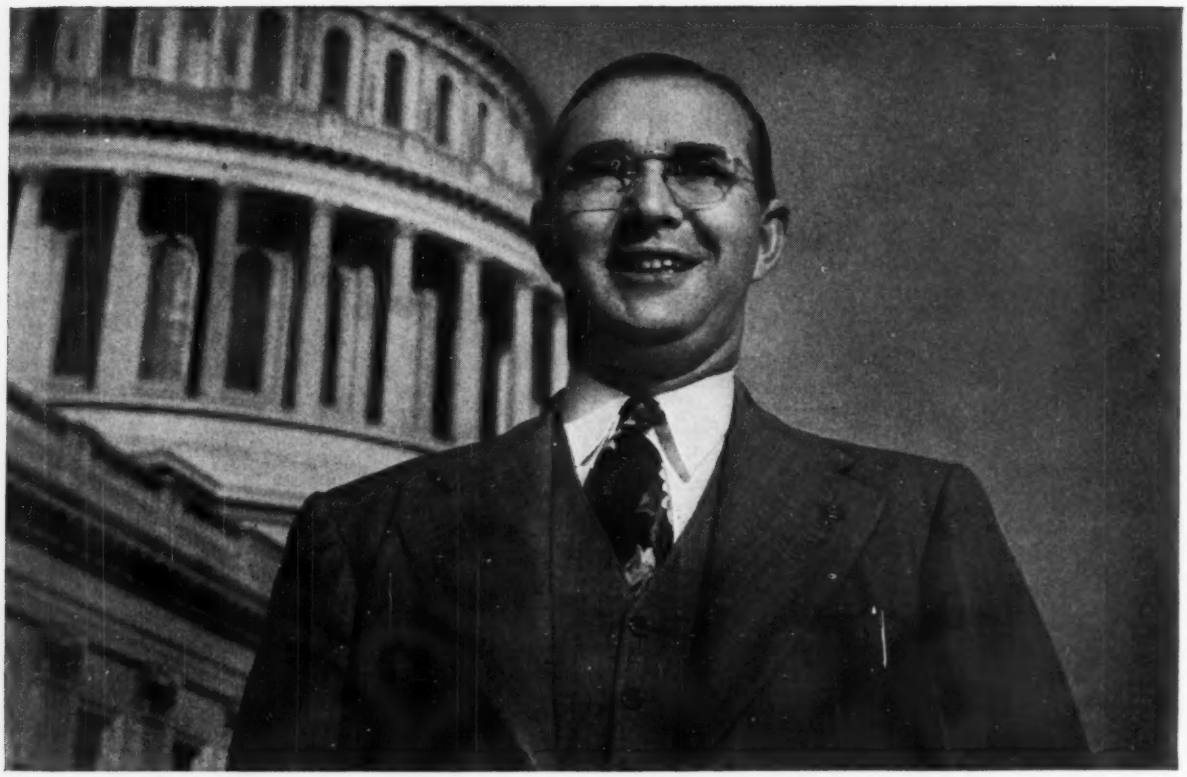

A Congressman votes "Yes!" for a tire!

(So will you)

You'll vote for Super-Cushions too, once you learn what a smooth, safe ride they give you. Here's what Congressman Victor Wickersham of Oklahoma says about *his:*

"In my last Congressional Campaign, I covered over 30,000 miles on all kinds of roads with one set of Super-Cushions. They really improve the car's performance. Steering is easier. And Super-Cushions make the car hug the road on turns, give me excellent traction even in wet weather."

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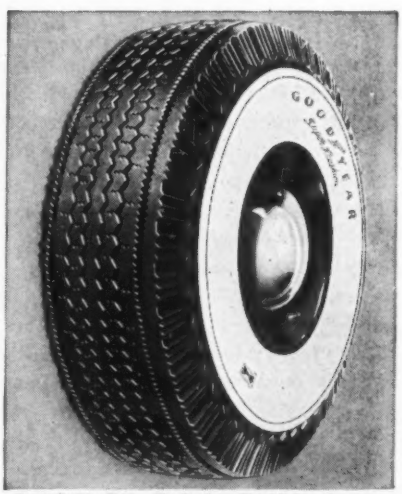
The Super-Cushion is bigger and softer . . . runs on 24 pounds of air . . . but will fit your present wheels!

You'll get a *softer* ride, less wear on your car, fewer rattles and repair bills, greater safety, mileage and blowout resistance. *See your Goodyear dealer today!*



Super-Cushion T. M.—The Goodyear Tire & Rubber Company

Super Cushion

by GOODYEAR

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Paul L. Rittenhouse

THE TECHNOLOGY REVIEW

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CONTENTS *for June, 1949* VOL. 51 No. 8

AERIAL VIEW OF SPILLWAY AT FORT PECK · *Photograph by Post-Dispatch from Black Star* ..... THE COVER

NEW YORK'S GRAND CANYON · *Photograph by Joe Covello from Black Star* ..... FRONTISPIECE 496

AMERICA'S FIRST HALF CENTURY OF FLIGHT By S. PAUL JOHNSTON 500
Invention of heavier-than-air machines, scientific study of air flow, and great progress in power plants mark the significant points in five decades of aviation history

TRAITS OF THE WRIGHT BROTHERS ..... By FRED C. KELLY 504
Personal characteristics of the brothers who first flew heavier-than-air machines are recorded by one who knew them intimately

FACTS AND FIGURES ON THE WHITE-COLLAR WORKER ..... By PAUL MEADOWS 508
Although most representative of all occupational groups, the large and rapidly growing army of nonmanual workers which industrialization has developed faces its own peculiar problems

THE CENTENNIAL OF 1876 — HIGH TIDE OF CONFIDENCE ..... By E. H. CAMERON 511
The exuberance of a century of national progress was vividly reflected in the Philadelphia Exposition which stimulated subsequent development in the United States

THE TABULAR VIEW · *Contributors and Contributions* 490

MAIL RETURNS · *Letters from Review Readers* 492

THE TREND OF AFFAIRS · *News of Science and Engineering* 497

THE INSTITUTE GAZETTE · *Relating to the Massachusetts Institute of Technology* 515

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Joe Covello from Black Star

New York's Grand Canyon of City Streets

THE
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The Trend of Affairs

Proof of the Pudding

THE addition of nutritionally essential vitamins and minerals to staple foods, now widely practiced in the United States, has been the target of some rational skepticism. Critics have argued: granted that local surveys indicate the existence of malnutrition in this country; and granted that laboratory studies show that the addition of specific nutrients to the diet can remedy such deficiencies; nevertheless, the final element of proof, evidence of improvement of nutritional deficiencies in sizable population groups by vitamin-mineral fortification of their food supply, has been lacking. Such evidence has just become available, however, as a result of surveys conducted in Newfoundland in 1944 and in 1948, with universal enrichment of flour and bread, and fortification of margarine, enforced there between the time of the two surveys. (The final results of the Newfoundland demonstration were presented, by the team of eminent scientists who did the work, before a special meeting of nearly 1,000 physicians, nutritionists, food-industry representatives, and others interested in the nutritional welfare, at the Hotel Biltmore in New York City, on April 4, 1949.)

Newfoundland was an ideal place to study effects of radical improvements in nutritive value of the food supply. It is an island; its population is stable, compact, and homogenous. The climate is harsh and the soil barren, with the result that little fresh food can be produced locally, and dependence upon food imports is almost total. Newfoundland's economic conditions, at least until recently, have been poor; practically the only source of livelihood has been precarious incomes wrested from the sea. It is not surprising, then, that through the years the existence in Newfoundland of disability due to malnutrition has been observed repeatedly.

In 1944, the public-health officials of Newfoundland concluded that addition of vitamins and minerals to staple foods might be an answer to the problem of nutritional deficiencies on the island. As a preliminary to such improvement of the food supply, the Government of Newfoundland in the summer of 1944 invited a group of prominent physicians and biochemists, from the United States and Canada, to evaluate the nutritional status of the Newfoundland population. At that time, the survey team found widespread evidence of malnutrition, including clinical signs and symptoms, levels of blood and urine constituents as revealed by biochemical determinations, the general temperament of the people, and even downright disability. The clinical and biochemical evidence obtained was objective and incontrovertible. Even more striking, although admittedly open to argument as based on subjective observations, was the demeanor of the people. Many of them were apathetic and listless. This dullness was particularly evident among the children, who were lethargic and disinterested, and who were said to have waited around like "little old men" for their turn to be examined. The specific nutritional defects found in 1944 were attributed to suboptimal intakes of Vitamin *A*, thiamine (Vitamin B_1), riboflavin (Vitamin B_2), niacin (another member of the Vitamin-*B* complex) and ascorbic acid (Vitamin *C*).

Upon completion of the 1944 survey, the Newfoundland Government made compulsory the fortification with Vitamin *A* of all margarine distributed on the island, and the enrichment of all white flour with thiamine, riboflavin, niacin, and iron. Later, bone meal was added to the flour, mainly as a source of calcium. At the same time, a program of nutrition education was begun. Furthermore, distribution of milk solids and of cod-liver oil was initiated in the schools, and free orange juice was made available to nursing mothers and to infants.

In 1944, there were 868 Newfoundlanders examined. When the survey team returned, exactly four years later, they were able to re-examine 227 of the same individuals they had seen in 1944; and enough additional persons were tested to bring the 1948 total to exactly the same as that for 1944. Both the large proportion of "repeaters," and the fact that the total group each time was numerous enough to constitute a statistically significant sampling of the entire population, make valid direct comparisons between 1944 results and 1948 results.

The observations recorded in 1948 revealed dramatic improvements over 1944 in some respects, but an equally striking lack of improvement in one regard. Abnormalities seen in 1944 and attributed to deficiencies of Vitamin *A*, thiamine, riboflavin, and niacin were markedly reduced in 1948. Biochemical determinations of blood and urine constituents related to these nutrients showed much closer approaches to optimal levels. Furthermore, the Newfoundlanders in general appeared to have become alert, rather than apathetic as they were in 1944. The children in particular were lively, mischievous, and curious, in keeping with their youth. Despite the fact that this latter improvement created some practical difficulties for the survey team, in holding the youngsters in order long enough to examine them, it was gratifying to the team as evidence of a highly desirable gain in nutritional status.

In addition to the nutritional improvements just described, it was discovered that the general death rate, the tuberculosis death rate, and the infant death rate all had fallen between 1944 and 1948. These changes cannot, however, be cited as direct evidence of nutritional gains, as the relationship of nutrition to longevity and resistance to disease is still controversial (see The Review, June, 1948, page 427).

Recall that in addition to the nutritional defects discussed above, evidence of Vitamin *C* deficiency had been observed in 1944. Signs of this particular type of malnutrition were actually more prevalent in 1948 than in 1944. This relationship serves as a valuable control on the demonstration. For between 1944 and 1948, economic conditions in Newfoundland had improved somewhat, mainly as a result of the placing of military and naval installations, and of commercial airports, upon the island. Hence, it might be contended that nutritional improvements occurring during the interval were due to availability of more money for food purchases, rather than to enrichment of flour and fortification of margarine. If this were true, improvements similar to those accomplished with regard to the *B*-complex vitamins and Vitamin *A* should also have occurred with respect to Vitamin *C*. This was not the case, despite the fact that the Vitamin *C* level of the Newfoundland dietary might have been improved as a result of limited free orange juice distribution, and also as a result of attempts made through educational means to correct traditional cooking methods that had tended to destroy a large proportion of the Vitamin *C* naturally present in foods. The lack of improvement in Vitamin *C* deficiency indicates that improvements with regard to the other nutrients is attributable to their addition to flour and margarine used by the Newfoundlanders.

Nutrition education and direct distribution of nutritious foods to special-need groups cannot be disparaged, as they are valuable parts of a well-rounded, long-term nutrition program. Nevertheless, the Newfoundland demonstration has shown that the most quickly effective way to remedy prevalent nutritional deficiencies is to add the lacking nutrients to widely consumed staple foods.

Rhine Messenger

In interested circles it was known for some time that the Germans employed three types of long-range missiles during the battle for Antwerp. One of them was the well-known flying bomb, *V-2*, and the other was the equally well-known, long-range rocket also known as *V-2*. The third type was said to be a long-range rocket known as the *Rheinbote* or "Messenger from the Rhine." Until the British Interplanetary Society recently succeeded in getting a general description of *Rheinbote* declassified no specific information about this rocket could be obtained for publication. Now it is clear that the *Rheinbote* was a remarkable, if not very successful, missile, and of more than usual interest because of certain engineering features which were anything but commonplace.

The *Rheinbote* was remarkable for two reasons: It was a solid-fuel, long-range rocket, and it was also the first rocket of large size to utilize separate units functioning successively in the so-called step principle. The *Rheinbote* consisted of three steps, that is, of three rockets forming a unit and operating one after the other. The whole was launched from a long platform which could be aimed and elevated in about the manner of the boom of a steam shovel, and having rails on top of this structure for initially guiding the missile in its takeoff.

The missile was a development of the firm of Rheinmetall-Borsig, and, as far as can be ascertained, was used only once, in November, 1944, when about 20 long-range rockets of this type were fired into Antwerp from the Dutch city of Zwolle. The total range was about 137 miles or 220 kilometers. When ready for firing, the missile must have been a strange-looking device. It was a long and rather narrow cylinder with a bulbous tail end from which six exhaust nozzles protruded, and equipped, at roughly regular intervals, with four sets of six stabilizing fins each. Each set of fins marked the lower end of one "step."

The performance of the missile may be determined from a graph published in the July, 1948, issue of the *British Interplanetary Society Journal.*

A booster unit was provided primarily to clear the rocket from the launching platform. The booster was electrically ignited and burned for only one second, accelerating the rocket to a velocity of about 820 feet per second (250 meters per second). After a delay of one second, during which the velocity dropped to about 700 feet per second, the first step or unit of the rocket was ignited by a fuse mechanism which was sensitive to acceleration. The delay in the ignition of each step appears to have been due to time required for the priming mixture to burn. The priming mixture consisted of a composition of nitroglycerine and flashlight powder which, in turn, ignited a charge consist-

Paul L. Rittenhouse

Despite continuous service to New Yorkers for more than half a century, the Brooklyn Bridge continues to draw enthusiasm and admiration, and provides a popular subject for photographers. As an amateur photographer in New York, Paul L. Rittenhouse has captured this impressive view of the famous engineering structure.

ing of black powder and a kind of aluminum thermite. In spite of its complexity, this method provided a sure way of igniting the propelling charge, regardless of temperature and other conditions encountered during flight of the rocket.

The first step, catching fire two seconds after take-off, burned for five seconds and accelerated the missile to a velocity of about 1,700 feet per second or 500 meters per second. The second step caught fire at the beginning of the 12th second, after the velocity had dropped to about 1,550 feet per second. The second step, burning for a period of five seconds, like the first, accelerated the rocket to a velocity of about 3,200 feet per second, or close to 1,000 meters per second. The third step caught fire at the beginning of the 22d second and burned for four and a half seconds. During the five-second delay, between the second and third step, the velocity had dropped to about 3,000 feet per second, but the third step accelerated what was left of the missile to a velocity of about 5,350 feet per second or 1,630 meters per second. The missile was launched at an angle of 65 degrees and attained a height of 8.7 miles, and, at a horizontal distance, of 6.2 miles from its launcher when all the propellant powder had been used up after 25.5 seconds of flight. After the powder was fully consumed, the unconsumed portion of the rocket, traveling on momentum only, reached the peak of its trajectory near the 130th second after take-off, when it was 49 miles (78 kilometers) high and 68½ miles (110 kilometers) from either launcher or target. Impact took place during the 260th second from take-off, 137 miles from the launching platform of the rocket.

The dimensions and weights of this missile are given in the table, adapted from the *British Interplanetary Society Journal* mentioned above.

	Dimensions		*Weights*	
	Feet	Meters	Pounds	Kilograms
Complete missile, length	37.4	11.4	3,773	1,715
Booster unit, length	6.23	1.9	1,529	695
Booster unit, diameter	1.71	0.535	—	—
Booster unit, propellant	—	—	539	245
First step, length	11.5	3.5	935	425
First step, diameter	0.88	0.268	—	—
First step, propellant	—	—	308	140
Second step, length	11.5	3.5	869	395
Second step, diameter	0.88	0.268	—	—
Second step, propellant	—	—	308	140
Third step, length	13.1	4.0	440	200
Third step, diameter	0.623	0.19	—	—
Third step, propellant	—	—	132	60

The warhead had the same diameter as the third step, its length and over-all weight are included in the figures for the third step given in the table. Together, the burned-out third step plus the warhead which arrived at the impact point weighed 297 pounds or 135 kilograms. The weight of the warhead proper was 88 pounds or 40 kilograms. This is slightly less than the 95-pound weight of the shell of the 155-millimeter *Long Tom*. The warhead of the *Rheinbote* probably accounted for more than 60 per cent of the weight of the warhead. Since the weight of explosive in an artillery projectile is only from 10 to 15 per cent of the weight of the shell, the *Rheinbote's* warhead contained more explosive than the *Long Tom* shell.

To transport some 60 pounds of explosive over 137 miles required the expenditure of a three-step rocket with booster, and a total of almost 1,300 pounds of propellant. One wonders whether the German engineers who designed this rocket actually thought that they were producing an effective weapon or whether They were merely indulging in an experiment. In the case of the *Rheinbote*, the latter proved to be true.

AMERICA'S FIRST
Half Century of Flight

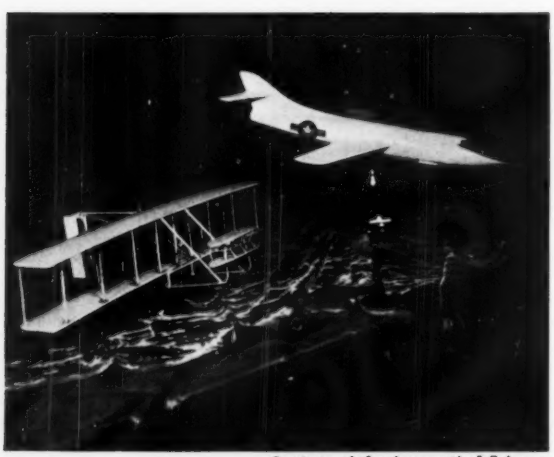
Invention of the Airplane, Scientific Study of Air Flow, and Development of Highly Efficient Engines Mark Progress in Mechanical Flight

By **S. PAUL JOHNSTON**

To those of us who sometimes think of World War I as only yesterday, it comes as somewhat of a shock to realize that the history of heavier-than-air flight is about to round the half-century mark. Although we may have spent a lifetime in this aviation business, to us it is still fresh and new. Most people at 50 have collected a bit of moss around the edges and are beginning to creak at the joints. But aviation, after having survived an anemic youth and a colorful and reckless adolescence, is only now approaching the brink of its maturity. Any story of the first half century of mechanical flight is, therefore, but the log of a take-off, a record of the launching of a flight that will carry man toward horizons beyond his present dreaming. The stars are yet a long way off, but we are closer to them than we were in 1899!

It is impossible to record here the details of those formative years – all the mistakes that held us back, all the achievements that carried us ahead. Whole libraries have been written on such subjects and the story is far from complete. The important thing is not "what happened?" but "where are we going?" As in tracing the history of individuals, we must try to recognize the critical landmarks that establish trends. Once the curve has been plotted we may extrapolate a forecast for the future with some degree of assurance.

The most obvious, and also somewhat hackneyed, approach is to seek a measure of aviation progress by studying the achievements of pilots who have made headlines. We read, for example, how T. Roscoe Merriwell astonished his neighbors in 19– when he attached a sewing-machine motor to an old box kite and flew around his father's cow pasture. A few years later the local press notes Roscoe's remarkable flight up the West Branch of Muddy Creek – "no hands." Presently we find our hero battling his way across the stormy South Atlantic in a flimsy quadriplane, provisioned only with a fried-egg sandwich and a bottle of cold tea. Next year, in a supersonic space ship he will visit the moon. And so it goes.



Institute of the Aeronautical Sciences

A study in contrasts. The Wright brothers' biplane of 1903 and a model of the Douglas Sky Rocket.

But such things, astonishing as they may be, are only the symptoms of aviation progress. They are the things that gay, and gallant, and sometimes foolish men do with tools that are furnished them by men who seldom make the headlines, the aeronautical scientists.

In the beginning, the experimenter, the scientist, and the pilot were generally indistinguishable. They were, more often than not, one person. But since the end of the trial-and-error period of aviation history (about the beginning of World War I), that has not been true. The really significant milestones have been set up by men who have spent their lives peering into test tubes, laboring over drafting boards, and running wind tunnels, towing tanks, and test cells of research laboratories. Aviation progress has always been dependent upon the engineer and the scientist. Actually, every chapter of the story of air progress was already written by the time the headlined pilot stepped into the cockpit.

Let us consider, then, the significant milestones that have been erected by the aeronautical scientist during the past half century. Again, the record here cannot pretend to be complete. From a quick survey of the highlights, however, the reader may readily deduce for himself why certain pilots were able to do certain things at certain periods in aviation history. He may also be able to forecast, with some accuracy, what pilots of the near future may be able to accomplish in the air.

Before the turn of the century, Samuel Pierpont Langley made a thoroughly scientific approach to the problem of flight. If he failed to achieve his goal, it was not for lack of long and painstaking research. In his pre-Smithsonian days, as a professor in Pittsburgh, he built a whirling-arm device on which he tested the aerodynamic characteristics of birds and of bird wings, and studied the air resistance of various ob-

jects. No hit-or-miss researcher, he recorded his data in great detail. Although his findings may have been insufficient for his purposes, or possibly he himself misinterpreted them, his approach was sound. He must certainly be credited with the title of our "First Aeronautical Scientist." Abortive as it turned out to be, his work must be listed as significant.

Then came the Wrights. Wilbur and Orville were tireless experimenters. They lacked the formal education of the scientist of the day, but they more than made up for it by their insatiable curiosity. They constantly sought explanations for the observed behaviors of their kites and gliders. Before they attempted to build their first powered airplane they built a wind tunnel to check those observations. It was certainly the first in America. They made endless computations, checked their theories of lift and drag of wings, tested various propeller sections and blade forms. They studied Langley's data. They were familiar with the results obtained by Lilienthal in Germany. Thus they became sure of themselves. Long before 1903 they knew that they could fly. They had proved it to themselves, by research.

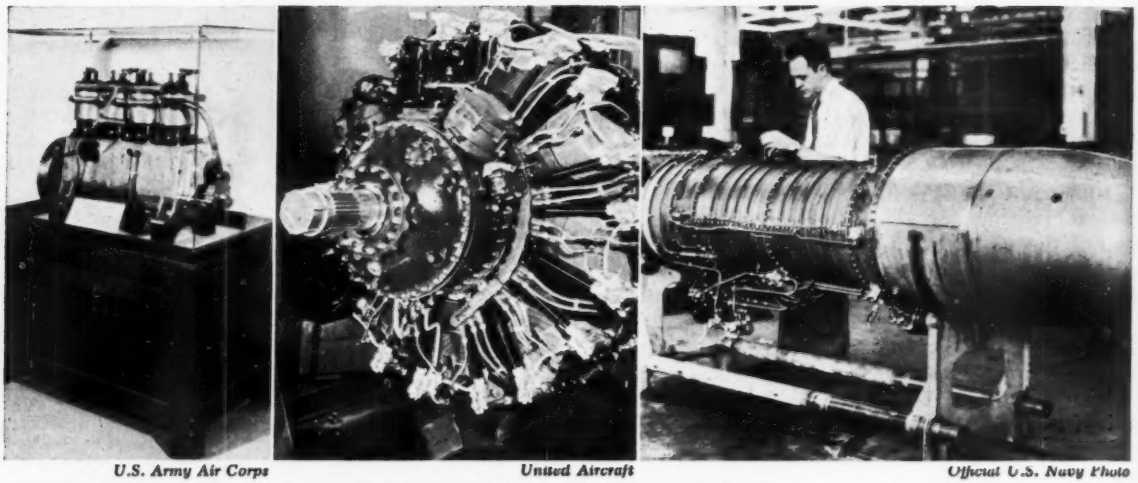
Once it was proved that mechanical flight was possible, the scientific spirit that had animated Langley and the Wrights languished for a time. The decade 1904–1914 was characterized by mechanical rather than scientific genius. Practical men took the basic principles that had been established by the Wrights, and developed bigger and better flying machines of the same general pattern. Progress was made, but by cut-and-try methods. Airplanes became larger, sturdier, more manageable. They flew somewhat faster, and quite a bit farther. By 1913, for example, an assault on the North Atlantic was projected by Glenn Curtiss. But we were well into World War I before much serious thought was given to long-range improvement via the channel of planned scientific research by trained personnel.

As a matter of fact, we were well into the third decade of the Twentieth Century before any really significant changes occurred in the configuration of aircraft. The best of the post-World War I machines could be described in the same general terms used for the 1910 vintage. They were almost invariably stick-and-wire biplanes. They had thin, fabric-covered wings attached to some sort of enclosed or semi-enclosed fuselage. Engines were water cooled, with large protuberant radiators. Landing gears, unashamed, exposed their unlovely legs to the passing breeze.

As auxiliary devices were invented, matters progressed from bad to much worse. Radio masts, guns,

Transport Progress: (1—at top) *Boeing* 40-B *had an open cockpit for the pilot and a cramped cabin for four in the mail compartment;* (2) *The Boeing* 80-B *of 1930 was a first step in the direction of increasing passenger comfort and safety;* (3) *The Boeing* 247-D *was the transition between the* 80-B (above) *and the thoroughly modern types* (below); (4) *Workhorse of the air lines, the Douglas* DC-3 *came into service about 1935 and is still going strong;* (5) *Modern progress exemplified in the Lockheed Constellation. This type, together with the Douglas* DC-6 *and the Boeing Stratoliner, now comprises the bulk of our four-engine air transports.*

Boeing Photos (top three)
Inst. of Aero. Sciences (fourth) *Pan American Photo* (fifth)



U.S. Army Air Corps | United Aircraft | Official U.S. Navy Photo

Engines have become bigger and more complicated. (left) *This simple, four-cylinder, 28-horsepower automobile type engine, developed by the Wright brothers, flew the Army's Wright biplanes in 1909.* (center) *The air-cooled radial engines reached a high degree of efficiency in time to power most of the fighting planes of World War II. Shown here is the Pratt and Whitney 2,400 horsepower double Wasp.* (right) *The advent of the turbo-jet engines has opened up a whole new era of aircraft performance.*

and landing lights were simply attached in the most convenient spots. Finally, aircraft became so incredibly encumbered that the poor engine builders began to despair of ever providing enough power to drag them through the air.

Then, almost overnight, came the revolution. The modern, clean, all-metal airplane, with everything retractable that was not needed for flight, put in an appearance *circa* 1930. Offhand, that seems a good point to erect another milestone for science. But these new and efficient machines had not sprung full-blown from the forehead of some inventive genius on January 1, 1930. They were the end point of long years of careful and patient research by many men. Their genesis can be traced back to an event that occurred many years before they appeared in the sky.

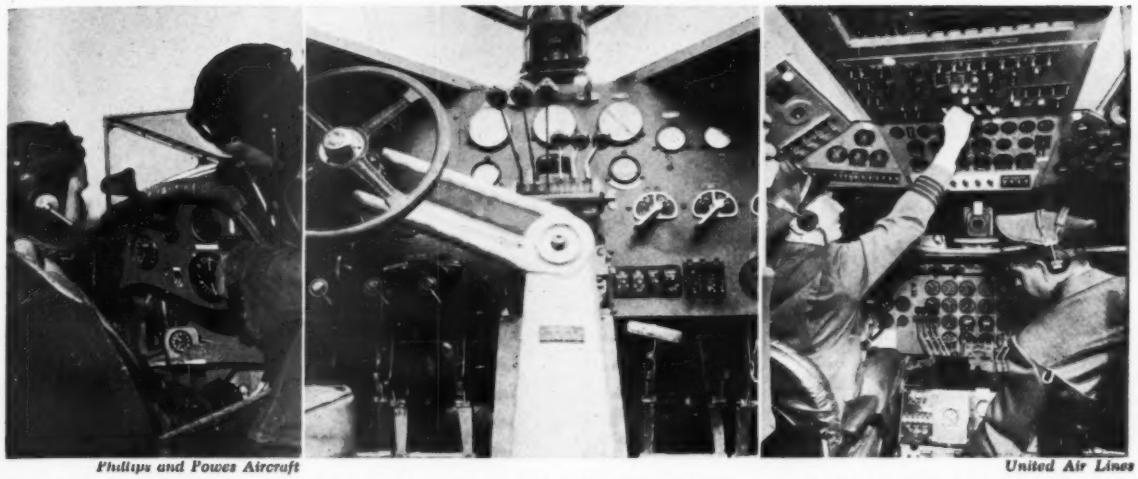
When the United States was finally drawn into war in 1917, it became quickly apparent that our collective ignorance in aeronautical matters was shockingly profound. Prior to 1914 we had lagged far behind other countries in developing aircraft suitable for military, or any other, use. When the crisis came we tried to catch up by adapting British and French airplane designs to our purposes. That effort proved both costly and abortive. We found ourselves getting nowhere at all. Then came the event that must certainly be marked by a milestone. The National Advisory Committee for Aeronautics was formed to "advise" the President and the Congress what to do about aviation. That was the real turning point; the rebirth of the scientific approach. For a time, the National Advisory Committee for Aeronautics was simply an advisory board. It soon became evident, however, that it could not produce much in the way of constructive suggestion unless it could perform some practical research on which to base its recommendations. A little money was set aside for the purpose, a few aircraft were assigned by the Army and the Navy, a few people (engineers, physicists, and pilots) were recruited. A small corner of Langley Field, Va., was staked out as a temporary site for this country's first research laboratory in the aeronautical sciences.

As a matter of fact, no special monuments need now be erected to mark that event. The great laboratories of the N.A.C.A. at Langley Field, at Moffett Field, and at Cleveland stand as evidence of the importance that we now attach to the scientific approach to our aeronautical problems. From them have stemmed the basic scientific data from which our modern airplanes have been evolved. They have been continuously at work to find better wing sections, to improve control at high and at low speeds, to reduce drag and to increase power-plant efficiency. The evolutionary processes of research in various fields – aerodynamic, structural, propulsive, and operational – produced results that made possible the revolution in airplane design that occurred in the late 1920's. The excrescence-studded stick-and-wire biplane types of World War I gave way to the clean and efficient, smooth-skinned monoplane of today, on which even an exposed rivet head is *de trop*, largely due to the pioneering work carried on by the National Advisory Committee for Aeronautics.

At that point we made a real break through the performance limitations of the 1920's. Designers had been working in an area of diminishing returns. Now the lid was off. In the space of a few years, airplane speeds doubled, ranges went up in thousand-mile increments. At the same time, operating efficiencies were realized that made commercial operation of air transportation an economic possibility. And, for the first time, the airplane became a really terrible weapon of war.

Progress over the first few years of the 1930's was rapid, as designers took full advantage of the possibilities of the new types. It was then that the *DC-2's* and *DC-3's* replaced the Fords and Condors on the air lines. Then, too, box-kite bombers and fighters gave way to the Martin *B-10* and Boeing *B-17* bombers, and the famous fighters in the *P-36, P-38, P-40,* and *P-47* categories.

But well before the outbreak of World War II another area of diminishing returns was reached. With the best of the new designs, with the best of the power



Phillips and Powes Aircraft — United Air Lines

Cockpit contrasts: (left) *In the 1920's pilots had few instruments and relatively little to watch inside the cockpit.* (center) *The 1930 cockpits were complicated mainly by the addition of multiple engine controls, but were still within the capabilities of a single pilot's comprehension.* (right) *The complicated cockpit of a modern air liner (in this case a Douglas* DC-6) *requires the combined and continuous attention of two or three men. Modern practice puts engine controls in the hands of a flight engineer.*

plants then available, airplanes could go only so far, so fast. In spite of intensive research by the N.A.C.A. and other agencies during the 1930's, airplane performance was making an obviously asymptotic approach to predictable limits.

The controlling factor was power for propulsion. The aerodynamicists, through increased knowledge of air-flow phenomena, had reduced the power required for flight to a remarkable degree. At the same time, engine researchers and engine builders had not been idle. They continuously stepped-up the power of engines and the efficiency of propellers. But as "our wings grew faster," the power-required curves began to diverge from the power available. Bigger power plants needed larger and larger airplanes just to carry them. Drag went up, and as speeds approached 500 miles per hour, propeller efficiencies went past their peaks. Once again definite performance ceilings were in sight.

This situation persisted during most of World War II. Then another event occurred for which another milestone must be erected – the advent of jet and rocket-power plants.

Born of intensive research in Germany and in England, and later in the United States, these newer types of engines put almost unlimited power into the hands of airplane designers. Power available curves again soared sharply upward, quickly passed the parameters of power required by such a wide margin that former performance limits were quickly forgotten. Flight at supersonic speeds, demonstrably impossible by former standards, immediately became something to conjure with.

It is now well known that the so-called sonic barrier has been breached, not once, but many times. The grave difficulties and dire perils that were suffered to beset human pilots who dared exceed the speed of sound have turned out to be largely products of the imagination – by-products of our inborn fear of the unknown. As scientific step-by-step methods have been applied to such seemingly insurmountable problems, the solutions have unfolded before us.

In this brief survey of the first 50 years of mechanical flight we have identified but three milestones: the invention of the airplane itself (1899–1909); the scientific study of air-flow phenomena that led to low-drag airplanes of today (1918–1928); the research that led to the development of engines capable of extracting tremendous power efficiently from chemical fuels (1940–1950).

In any roomful of aeronautical people, many, and violent, arguments would immediately break out. Oversimplification would be the major charge leveled at the preceding paragraph. Hundreds of other significant developments would be cited. What about materials development? What of instrumentation? Radio? Radar? Better fuels? Better this and better that? But, important as all those things may be, they are but trail blazers between the really major milestones. For the most part, they may be resolved back into elements of the larger problems.

What will be the next milestone and when? The first appears not too difficult of prediction. It will doubtless have to do with the application of nuclear energy as power for flight. What form it may take is impossible to say at this time, but there is no question that the appearance of a successful nuclear-powered engine of a reasonable size and weight would again revolutionize the concept of human flight. When such a thing will happen is another matter. The crystal ball is none too clear. The chances are, however, that there are undergraduates at Technology today who will be called upon to deal with the practical engineering aspects of the problem before they finish their careers. Who can predict whether the call will come in five, ten, or twenty-five years?

The comic-strip artists and science fiction writers are again having a field day. From Jules Verne to Rick Yager their stock is going up. Little that they predicted in the past has failed to come true, so why hold back now? New York to Paris in an hour? Rockets to the moon? Man-made earth satellites? Yesterday's difficult problems are being solved today. Have patience, the impossible ones will take only a little longer.

TRAITS OF
The Wright Brothers

Modesty, Thoroughness, and Practical Common Sense Characterized the Two Brothers Who First Flew in Heavier-Than-Air Machines

By **FRED C. KELLY**

IT is unlikely that either Wilbur or Orville Wright working alone would have invented the airplane. The job seemed to require this glorified team, each giving advice and support to the other. By carefully weighing and vigorously combating each other's theories, they overlooked no snags.

At times their minds seemed to act as one. An example of this was startling, almost beyond explanation. After they had been working late one night in their shop, Orville returned home on nearby Hawthorne Street a little ahead of Wilbur. He was in bed almost asleep when he heard Wilbur come in. A surprising thing was that Wilbur forgot to bolt the front door. Orville reminded him of his oversight. Then when Wilbur went back downstairs to put on the lock, Orville thought to himself, "It isn't like him to be so absent-minded. I'll bet he does something else peculiar. He'll blow out the gas in his room." Why he thought Wilbur would blow out the gas, instead of turning it off, he never could explain; but he felt sure of it. Fearing he would drop off to sleep he sat up in bed until he saw that the light in Wilbur's room was out. Then he went to investigate. Sure enough, the gas was still turned on; Wilbur had blown out the flame! Except for Orville's presentiment they both could have been asphyxiated.

They found it fun working together. Once in speaking to me of an acquaintance who seemed to be seeking happiness through material possessions, Orville shook his head and said: "I can remember when Wilbur and I could hardly wait for morning to come to get at something that interested us. *That's* happiness!"

Wilbur, at the beginning, seems to have had more hope of flying than Orville did; and he felt more disappointment when progress was slower than expected. At the end of the 1901 gliding experiments, Wilbur declared it would be "a thousand years" before man would fly. He doubted if it would be worth while to do any more gliding, even after the brothers' wind-tunnel research had given them the knowledge (which their predecessors had lacked) to build wings of the right design. Until a week before they set out for Kitty Hawk for the 1902 experiments, Wilbur was not sure he would go. Orville had to use all his powers of persuasion to rekindle Wilbur's enthusiasm.

The brothers were about equal in ability to work with their hands or with tools, and they were alike, too, in their feeling that so long as they followed sound principles and attained mechanical precision it was not essential to be too refined in workmanship in the sense of making a device look pretty. Their first powered machine may seem almost crude in comparison with other machines with which men tried to fly, but the difference was that theirs could fly! When absorbed in his thoughts, Wilbur, more than Orville, was inclined to be oblivious of his surroundings or of whatever he was doing. Sometimes he would slowly pace the floor with hands clasped behind him humming a popular song, and there were often long lapses between words. Once he was softly singing, "The flowers that bloom in . . ." and after a minute or so one of his nieces yelled: "Uncle Wilbur, aren't you *ever* going to say *spring*?"

Orville sometimes upbraided Wilbur for talking to him as if he were still a "kid brother," but there was complete sympathy between them. Even before they started to work on their first glider, they had quit keeping separate bank accounts. Each drew as much money as he wanted from their joint account in the Wright Cycle Company, and neither paid the slightest attention if one spent more than the other. When Wilbur received prize money for one of his flights in France, it was reported that he promptly counted out Orville's share. The truth was that he handed it all to Orville, who usually attended to their banking.

When they had conferences with others, Wilbur was likely to do most of the talking. This was not because he was the more communicative. Orville felt that the older brother was entitled to take the lead. Wilbur was more disposed than Orville to talk with newspapermen – probably because he had more faith than Orville in the value of publicity. In ordinary conversation, however, Wilbur was the less communicative of the two.

Yet, at one time, Wilbur considered becoming a lecturer. After the successful experiments with the 1902 glider, he wrote to the Redpath Lyceum Bureau suggesting that he be booked to lecture on man's attempts to fly and the nature of the problem. The Bureau's reply in December, 1902, was that such a lecture might be successful provided it included enough humor! If Wilbur would furnish a lantern operator and pay all his expenses, he might receive from $50 to $75 for each lecture, less the Bureau's 20 per cent commission. As it did not promise a bonanza, Wilbur gave up the lecture idea.

It was a great day at Kitty Hawk when a heavier-than-air machine carried the first human being in flight. By today's standards, the early flying machine was a fragile affair, but photographers were on hand to record the event permanently on film.

Keystone View Company

Neither Wilbur nor Orville was much given to paying compliments. Roy Knabenshue, who was in charge of the exhibition work in the early days of The Wright Company, recalls the time he suggested to Wilbur that since a certain employee was doing excellent work it wouldn't hurt to let him know it was appreciated. Wilbur's reply was something like this: "He knows we like his work. Why tell him so? Did I ever tell my mother I loved her? Or did she say she loved me? Of course not. That was understood. When Orville had his accident at Fort Myer I never cabled from France I hoped for his speedy recovery. He knew I would hope that."

Wilbur liked to write, and could express himself with clarity. When he prepared his first draft of the application for the Wrights' basic patent, which later stood the test of the courts, he never had to revise more than a phrase or two. From early youth Orville had the same gift for lucidity in the written word; but unlike Wilbur, he found writing irksome and never did it for fun. Wilbur's letters, particularly those to his family, usually showed his characteristic humor. In England he went to look at an airplane an experimenter had been working on. The designer had added one thing after another, trying to make it capable of flight, and Wilbur described it as remindful of an old English country house, remodeled from time to time, to which had finally been added a sleeping porch and a summer kitchen.

Wilbur Wright Meets Gelett Burgess

At the time Wilbur was flying in France, Gelett Burgess, '87, the American author, sent him a note from Paris, asking to see him. Wilbur wrote back that he'd be glad to meet him as he had read one of his books more often than any other. Burgess supposed that Wilbur referred to a book of philosophical essays. Wilbur never told him that the book was one of verses for children. He had read them over and over to his nieces and nephews, along with Mother Goose!

One casual remark by Wilbur has since been quoted all over the world. When he was asked to make a speech at a dinner in Paris he said: "I know of only one bird—the parrot—that talks; and it doesn't fly very high." Wilbur's humor in his early youth sometimes showed itself unexpectedly, to the great delight of Orville's playmates. One night he gave a little talk before a group of friends, and the next day Orville's chum, Edward Sines, asked him if he couldn't repeat the gist of it.

"I can let you hear a phonograph record of it," Wilbur solemnly replied. He stepped into an adjoining room and in a squeaky voice, imitating the phonograph recordings of those days, gave what he said was his talk of the previous night. Not one word was intelligible and every few seconds he interrupted himself with cheers, laughter, hand clapping or stamping of feet, supposed to come from his audience.

Orville, too, always had plenty of humor, although it was usually less homespun than Wilbur's. I once showed him a letter from someone who thought the early Wright flights during 1903, 1904, and 1905, should not be counted as antedating all those by later experimenters, because, said the writer, they were not witnessed by any committee of scientists. I shall never forget the phrasing of his comment: "Here is a great opportunity for someone – why not you? – to crowd the name of Columbus out of the pages of history. Columbus failed to have 'officials' of a regular organization, created for the special purpose of homologating discoveries, on hand when he landed in America!" That word homologate was a new one to me. I found that it means to declare approval.

Sometimes it was not easy to be sure whether it was his humor or his modesty that found expression. One night Milton Wright, a nephew of Orville, called him by telephone to tell, with fatherly pride, of the fine

scholarship record his son had made in high school. "At that rate," remarked Orville, "the Wright family may become famous.

Some years ago, when Griffith Brewer, then President of the Royal Aeronautical Society in Great Britain, was Orville's guest, the talk turned to how simple and easy an invention often looks after it has been made, so much so that almost anyone might think he could have done it. Then Brewer quoted a line of poetry "– so easy it seemed, once found, which, yet unfound, most would have thought impossible."

"I have been trying for years," said Brewer, "to find out who wrote that line." He and Orville began to ransack books of quotations, but could not find what they sought.

By strange coincidence, in Orville's mail the next morning, was a letter from a man in Seattle seeking an autograph. The writer quoted that line of poetry, and gave the source; Book VI of Milton's *Paradise Lost*. Orville said nothing about this windfall, because it had put into his head an idea for a practical joke. That night after dinner, Orville located his copy of *Paradise Lost* and surreptitiously slid out a book half an inch or so, on the shelf just above it, to serve as a marker. Then he said to Brewer: "It looks as if we're never going to be able by ordinary research to identify the author of that line of poetry about invention – so maybe we ought to try psychic means." Brewer looked shocked that so eminent a scientist should speak such nonsense.

To put Brewer into a proper frame of mind for witnessing psychic phenomena, Orville then told him the story about his presentiment that Wilbur would blow out the gas. "I'll blindfold myself," Orville went on, "and see if I can be guided by psychic means to whatever book that quotation is in." He tied his handkerchief over his eyes and began to grope along the rows of books in his library. When his hand touched the one he wanted, he said, "I feel a strong impulse to pick up this book."

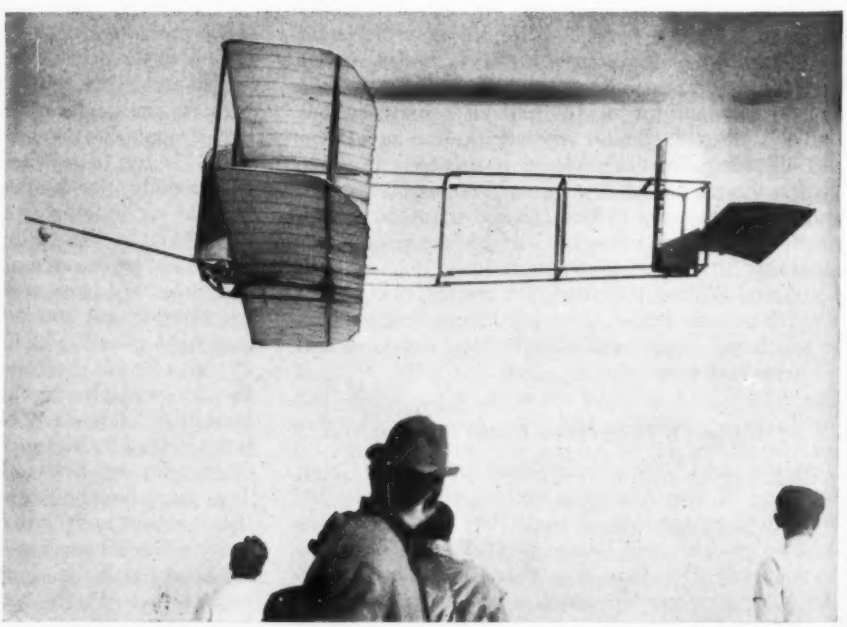
When Brewer recognized the volume which Orville had selected he said, "I don't think you'll find it there. The quotation doesn't sound like Milton."

"Let's take a look anyhow," suggested Orville; "there must be some reason for my impulse to pick it up." In a few moments of thumbing through the pages he had located the lines about invention. Naturally Brewer was amazed. He wondered about this feat all the rest of his life, for Orville thought the joke too good to spoil by explanation.

Thanksgiving Turkey

Once, as a minor prank, Orville prepared a turkey in a special way for a family dinner on Thanksgiving. Nearly all his nieces and nephews preferred dark meat and this time they were surprised that, as Uncle Orv carved, the supply never gave out. One of them remarked: "This is good turkey, but do you know it tastes a little like duck." Then Orville shook with laughter as he turned the platter around to show that the turkey was only a front. Most of the dark meat *was* duck.

Contrary to the common impression, Orville loved conversation. More than one of his friends has remarked that, no matter how late at night, he was never known to yawn and never seemed to be talked out. During World War II one of his grandnephews attending Miami University, not far from Dayton, persuaded him to come and spend an evening at a fraternity house. The other boys in the group wondered how they would talk to a man of his supposed taciturnity. They soon were quite at ease, because Orville promptly began to do most of the talking. One of the boys, taking a preliminary course in aviation, happened to mention something in his textbook that he didn't understand. Orville looked puzzled and asked to see the book. After reading a paragraph he said: "Oh, this is wrong," and wrote a correction in the margin. Then at the student's request he added his ini-



Rare historical photo showing one of the early Wright brothers' experiments with gliders prior to their famous flight at Kitty Hawk. Shown here is a group of persons watching a glider in flight shortly after the turn of the century.

Fotograms

tials. What those boys remember of that evening is not alone their contact with a keen mind, but the pleasure of having a charming, unassuming guest who contributed wonderful conversation.

Sometimes his part in a conversation was only a surprising remark. Some one in a group raised the question of the desirability of a nap after dinner. After much discussion all agreed with the accepted medical belief of the time that a nap right after eating is not good for one's health because more circulation of the blood is needed to aid digestion. Then came Orville's dead-pan comment: "If you are correct, think what a mistake dogs have been making!"

Persistently a bachelor, Orville liked to talk with women, provided they were married and accompanied by their husbands. He found disturbing an unattended woman who showed any interest in him. One woman gave him an alarming experience. The widow of a man he had known in Europe came for a short tour of the United States, and without much advance warning wired him that she would stop in Dayton to pay him a visit. Orville arranged to have one of his nieces at his home as hostess. He was much preoccupied, wondering how long the visitor planned to stay. She happened to remark that while in the United States she hoped to see Niagara Falls.

"Oh yes," spoke up Orville, "you mustn't miss Niagara Falls. It's not always easy, though, to get train reservations. Let me see what I can do," and he rushed to another room to telephone. When he returned, he said to his guest, "You are fortunate. I was able to engage you a berth on the train that leaves at four o'clock this afternoon."

Orville Wright Evaluates the Airplane

Orville was conservative in his estimate of the value of the airplane. At the time of the sesquicentennial anniversary of the founding of the United States Patent Office, he and a number of other scientists were asked to list the 10 inventions of the last 100 years they considered the most important. He took the word important to mean usefulness in the everyday life of an average person. His list of 10 inventions included the telegraph, the telephone, the air brake, the perfecting press, the Linotype machine, and radio – but *not* the airplane!

The trait in Orville Wright that always impressed me most during a third of a century of intimate acquaintance was his aim for accuracy and precision in all he did. Instinctively a perfectionist, he was tolerant of careless statements by others, but his own had to be right. In seeking more information about his childhood, I once said to him: "One Monday morning with your face freshly washed you set out for school for the first time. Can you remember what happened that day?"

He looked at me intently for a moment and replied: "I'm not absolutely sure it was on a Monday."

During the three years I worked closely with him, on the biography of the Wright brothers, there were many days when we got discouragingly little done. Once we put in 10 hours without any time off for lunch, and all we accomplished was to make sure of one date of minor importance. As we were leaving his office. I remarked that it had been a day of futility.

"Why do you say that?" he asked. "There's no longer any question about that date, is there?" He would have preferred to take a week to ascertain it rather than to risk authorizing a small misstatement.

His passion for accuracy was supported by an astounding memory. One evening I mentioned something I had written to him in a letter a year or so previously. He smiled and declared, "But I don't think that's quite what you wrote." Then he quoted precisely what I had written. It was nothing important and he had made no point of remembering it, but his mind had worked with its usual precision.

In his insistence on sticking to facts he could be stubborn. Near Dayton, on Wright Hill, which overlooks what was the Huffman Field where the Wrights made early experiments and later trained other flyers, there is a memorial monument and a bronze tablet on which are the names of all pilots who flew at Huffman. When the tablet was being prepared at Wright Field, Orville sent a list of names to go on it. The commanding officer, however, said they would omit the name of one man – Grover Cleveland Bergdoll – because he had become notorious as a draft evader in World War I, and the Army did not want to commemorate him. Orville pointed out that the tablet was intended to show the names of *all* the pilots and the list would be incomplete and inaccurate without Bergdoll's name; that his record as a draft evader did not change the fact that he had trained there as a pilot. The Army was unwilling to yield. Orville sent word that if Bergdoll's name did not go on, to omit also his own and Wilbur's! Then the Army gave in. Bergdoll's name is there.

I once asked Orville if there was any time during their experiments when he and Wilbur felt greatly discouraged. With characteristic clarity he replied: "When we discovered in 1901 that tables of air pressures prepared by our predecessors were not accurate or dependable, that was discouraging, in a way, and disappointing. For it meant that instead of starting from where others had left off, we must start from scratch. But, on the other hand, the fact that these data which others had considered accurate now turned out to be inaccurate, was interesting. One gets a certain thrill from discovering something others had not known. From one way of looking at it, you might even have called it encouraging, that the data others had used could not be relied upon. It suggested that maybe the reason others had failed to fly was not because the thing couldn't be done."

Perhaps the most interesting thing of all about Orville Wright was how little effect his distinction ever had upon his personality or his outlook. He had seen the Wright monument on top of Kill Devil Hill, ordered by Act of Congress, the most impressive memorial ever built to honor a person still living. But it seemed to interest him only as it did any other sightseer. He could not have been unaware that he and his brother were responsible for more revolutionary changes in the world than anyone since Columbus. Yet, except for being a little more retiring, he was still the same quiet, courteous, good-humored man who met customers at the Wright Cycle Company in Dayton 50 years ago.

FACTS AND FIGURES ON –

The White-Collar Worker

Unsung Symbol of the Process of Industrialization, Nonmanual Workers Are the Most Representative Unit of This Nation's Occupational Groups

By **PAUL MEADOWS**

EARLY in March of this year a retired industrialist, Joseph E. Uihlein, formerly head of the Schlitz Brewing Company, announced his personal plan to quit the directorship of a Milwaukee bank in order to devote the rest of his life to the unionization of American office workers. The United Press story indicated that he had already talked with American Federation of Labor leaders and had arranged similar conversations with Philip Murray of the Congress of Industrial Organizations.

This useful support from a totally unexpected source coincided neatly with announcements by national C.I.O. officials of intentions to invade the bailiwick of their lagging affiliate, the United Office and Professional Workers of America, which was accused of muffing the ball. National officers claim that they have been plagued with workers and local unions crying for affiliation. A.F. of L. officials have, since the close of World War II, also cast an appraising eye over the front offices of American business and industry and have drawn the lines of battle. Apparently the rather phenomenal experience with foreman unionism in the last five years has created serious doubts about the immunity of white-collar workers to union appeals.

Unquestionably the union representative knocking at the very door of office management these days is not only being invited in but is receiving a friendly audience.

Who, then, are the white-collar workers? How many of them are there? What are the salient features of their economic existence in American industrialism? What is on their mind? Will they "go unionist"?

A Rising Labor Force

The word historians offer no help in reconstructing the origins of the term "white-collar workers." Webster simply identifies them as the class of salaried workers, office and mercantile, "whose duties permit or require a well-groomed appearance." The English phrase is "black-coated workers." The French speak of them as "*employés,*" the Germans, as "*Angestellte und Beamten.*" The Bureau of the Census designates a group of occupations, roughly equivalent to "white-collar," by the phrase "clerical, sales, and kindred workers"; 31 different occupations are thus classified. "The binding idea," as occupation specialists H. D. Anderson and P. E. Davidson[1] put it, is "that they serve or promote transactions and report or record such activity." Among the most important categories are bookkeepers, cashiers, accountants, office-machine operators, stenographers, typists, secretaries, salesmen and saleswomen, shipping and receiving clerks, telegraph and telephone operators, attendants and messengers. The 1940 census listed slightly more than 8,000,000 white-collar workers, so defined, in the United States labor force. They comprised about one-sixth of the entire working population.[2]

The International Labor Organization, using a more inclusive system of classification, in a report published in 1936 grouped semiprofessional and administrative technicians with clerical and kindred workers under the category of "non-manual workers." The estimates showed a percentage distribution for these workers among the major countries of the industrial West that

Harold M. Lambert

Conservatism and strength of numbers characterize more than 8,000,000 white-collar workers in the United States, including bookkeepers, cashiers, accountants, office-machine operators, sales personnel, and similar groups.

ranged from a low of 12 per cent, in the case of Italy, to a high of 30 per cent for the United States.[3]

The growth of this class of workers is mirrored in the various statistical indices. Alba M. Edwards of the Census Bureau, confining (in this instance) the term "white-collar" to clerical workers, noted that in the two generations following the Civil War their numerical increase was slightly over 2,000 per cent, a jump from 2.9 per cent of the total labor force in 1870 to 16.3 per cent in 1930.[4] The rate of increase as reported in the Census for 1910 and for 1930 showed an upward spiral of 107.7 per cent for the clerical, sales, and kindred worker group as against 27.9 per cent for the total labor force. They increased twice as fast during this period as skilled and semiskilled workers, and nine times as fast as proprietors and managers; unskilled workers showed a proportional loss of 1.7 per cent in these statistics.

During the depression decade of the 1930's this group of employees practically balanced their gains and losses, as compared to craftsmen, foremen, and laborers whose losses exceeded gains. The war years greatly strengthened their position in the national economy. During a time when the general civilian labor force increased 11 per cent, clericals (though not sales people) increased 45 per cent – a growth which for the same period very slightly bettered the record of operatives, craftsmen, and foremen.

The wartime experience lends support to the prediction made by Mr. Edwards 10 years[5] ago that "in future years, the white-collar workers probably are destined to outnumber every other larger social-economic group, except, possibly, that comprised of unskilled workers."

A New Industrial Worker

The onset of World War II closed an industrial development in which the white-collar class had grown faster than any other occupational group, except public service. Indeed, almost perceptibly a new industrial worker came to maturity! What factors explain this story?

It may, in part, be traced to the changes which took place in business management during this period.[6] These changes refer to the emergence of filing, recording, cost accounting, systems of reports and estimates, sales promotion, systems of incentive-wage payments, government reports, trade analyses, and so on. Of strategic importance was the rise of the large-scale corporation[7] with its "batteries of typists, squadrons of file clerks, platoons of bookkeepers, and lively skirmish lines of office boys and messengers." The logic of the white-collar development, then, is a familiar one: specialization of function, standardization of operation, economy of volume production.

A technological factor underlies the expansion and work conditions of the white-collar force. The invasion of the front office by typing, recording, and mathematical machines has produced a new type of machine operative. For the power revolution of industrialism has reoriented the routines of the office and sales room, just as it transformed those of the shop. Office-equipment industries, experiencing luxuriant growth, have supplied the same demands for machinery as those which prompted the assembly line and mass production. Office and sales management, moreover, has paralleled the rigid production schedules and managerial controls of the factory: piecework, salary-incentive systems, job analysis, time and motion studies, and quotas organize the work-day world of the white-collar worker. His work situation appears to have become, in point of fact, an industrial work situation.

Social changes likewise are responsible for the emergence of the white-collar class in the modern economy. Rising levels of public education have made available men and women with training and background necessary for the special functions of the office and salesroom; in like manner, the stream of housewives outbound from the home seeking employment in business and industry has supplied a needed labor force. Both of these social changes reflect the higher social status attached to office and sales occupations: attractive work conditions, shortened hours (acquired earlier and more universally and without effort by white-collar workers), and opportunities for advancement to management.

The white-collar worker, thus, is an unsung symbol and agent of the processes of industrialization. The International Labor Organization report cited previously[8] noted that what is there termed "the nonmanual group" constitute "some 20 per cent of the gainfully employed, and the proportion tends to increase with the degree of industrialization."

A Personality Profile

Historically, the industrial position of the white-collar worker has been that of a rapidly growing middle class[9] – "a class between the better-educated and better-paid professional workers and the less well-educated and less well-paid manual workers." There is some evidence, to be noted subsequently, that his hold on this status is becoming tenuous. However that may prove to be, his proletarian middle-class role, so to speak, merits attention. What does the white-collar worker look like, socially and intellectually?

He is predominantly white (98.8 per cent). He is relatively young: three out of four white-collar workers are less than 45 years old. The sex ratio among this group is slightly overbalanced in favor of the males (53.2 per cent). He is largely urban (83 per cent). He is less subject to unemployment than the manual worker: five times as many of the latter were reported in the 1940 Census as employed on public emergency works. Among the males, one-third were listed as single in the last Census; among the females, a little over one-half. Educationally, there is some evidence that the median number of years of schooling exceeds that of the national average of 8.8 years.[10] Socially, indeed, there is little in his record which would belie the title of proletarian middle-class man, except probably his income data.

This impression is greatly strengthened by an examination of the opinion polls reported during the last eight years.[11] In 32 national polls calling for "yes-no" or "approve-disapprove" answers, American white-collar workers come closer to the national answers than any other group. Their percentage de-

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A. F. Sozio from Gendreau

Ewing Galloway

What does the white-collar worker look like, socially and intellectually? He is predominantly white. He is relatively young: three out of four white-collar workers are less than 45 years old. The sex ratio among this group is slightly overbalanced in favor of the males. He is largely urban. He is less subject to unemployment than the manual worker.

viations from the national average was 3.7 per cent, as against 5.5 per cent for the manual workers, 6.4 per cent for the business and professional, and 10.2 per cent for the farm group. It is not too much to say that the white-collar workers seem to be the most representative occupational group in America, so far as central tendencies on national issues are concerned. The relative lack of organization and of opinion-forming agencies among them is the most obvious reason for this fact.

White-collar reactions to Gallup poll takers (the American Institute of Public Opinion is the only poll that has consistently made an occupational breakdown of answers) are of course most definite to questions involving their occupational security or interests. A typical instance was the manner in which 58 per cent of white-collar employees (this was the highest figure for any occupational group) indicated in December, 1945, approval of a proposal that wages and salaries of civil service workers in Federal government should be raised 20 per cent.

Some of their replies are enlightening indices of their thinking. Thus, they varied in their support of the Roosevelt administrations from 51 per cent in 1936 to 45 per cent in 1946; but when asked in 1940 with which political party they identified themselves, only 36 per cent of them said Democratic. Asked in August, 1947, whether they would rather work for the Federal government, or for a private firm, 36 per cent checked the former, 39 per cent the latter. A poll taken that same month showed that over half (55 per cent) of them favored more taxes for scientific and military research. Three-quarters of them in September, 1946, favored a balanced budget (as against cutting income taxes). At the close of World War II, four out of five asked for active governmental postwar planning. In favor of government leadership in American-problem solving, nevertheless they seem to have made no particular effort to influence congressional action: 83 per cent told Gallup pollsters in June, 1946, that they had never written or wired a congressman or senator. About two-thirds of them would like to own their own business, as against a similar preference of 81 per cent for professional and business people, 80 per cent for farmers, and 61 per cent for manual workers.

(*Continued on page 522*)

THE CENTENNIAL OF 1876 – High Tide of Confidence

As the United States Faced the Future with Pride, 10 Decades of National Progress Were Commemorated in Philadelphia

By **E. H. CAMERON**

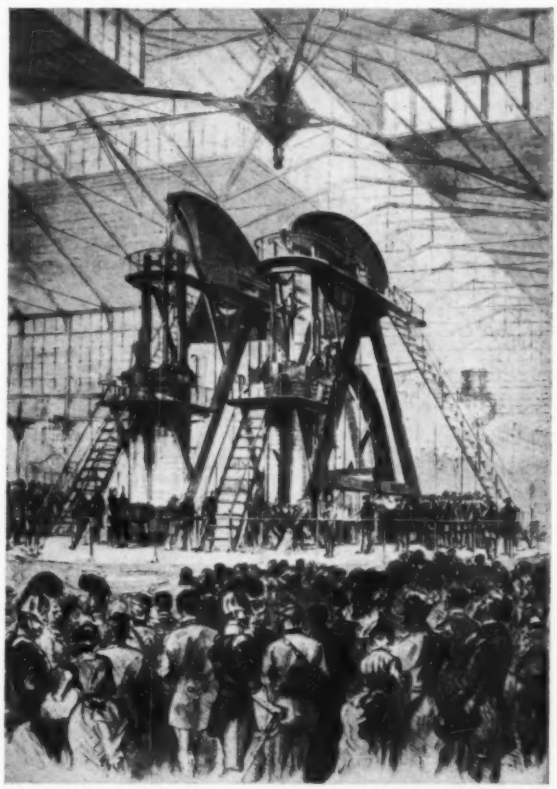
PART I

In the contemporary record of the good year 1876, as revealed by the books and periodicals of that year, one inspiring strain stands forth: a radiant confidence in the success of America. The expression of this high spirit is unrestrained – grandfather bragged prodigiously as to what he had done and what he planned to do next. His sturdy conceit is easy to forgive, however, when a study is made of the amazing examples of his industry and courage which the record describes. Even the severe financial panic of 1873 had been unable to break this splendid quality of faith that was to be displayed in the Centennial Exposition at Philadelphia three years later. Events seem to have justified this belief in America's destiny of success unlimited, in the Centennial year.

In its recent Civil War had not the strong, young nation solved its internal difficulties in such rugged fashion that hitherto hostile Europeans had promptly revised their attitude of superiority? In contrast, the ensuing eagerness to show their respect for American strength was a little comical. Great Britain had acknowledged its errors by concessions in the Alabama claims. France had sacrificed its sponsored Mexican Emperor, Maximilian, that the United States be not further offended by the grandiose imperialism of the French Emperor, Napoleon III. Gambling shrewdly, Russia had given the implied support of its fleet in the Civil War, and the payment for this grand gesture had been included in the $7,200,000 which America had paid for the supposedly useless terrain of frigid Alaska, in 1867, two years after the war's end. Even before the Civil War, imitative Japan had sent an embassy to learn the ways of the fantastically successful young democracy whose borders touched the Atlantic as well as the Pacific Ocean. As a sound background for the spirit of American assurance, there was a growing realization of the vast extent of the country's natural resources, now made readily accessible by the completion of the transcontinental railroad.

Fortuitously, this ascendancy of American spirit coincided with the nation's 100th birthday. The year 1876 was, therefore, selected as a suitable occasion for a world's fair to be held in Philadelphia where the Declaration of Independence had been signed a century earlier. The Philadelphia Centennial World's Fair was planned as one that should excel the six international exhibitions which had occurred during the preceding quarter-century. That the Centennial Exposition would fulfill its aims and surpass all others seemed assured by the enthusiasm of the vast throngs on the day of the opening ceremonies.

The great German composer, Richard Wagner, had written "The Centennial March" for the opening of the Philadelphia Exposition. To this gesture of international good will were added appropriate symbols of North-South reconciliations as a hymn by Massachusetts' John Greenleaf Whittier, and a cantata by Georgia's Sidney Lanier, were featured in the opening program. But even on the opening day, emphasis was on the practical, utilitarian aspects of life, as



Harper's Weekly

President Grant and Emperor Dom Pedro start the 2,500-horsepower Corliss engine which actuated machinery in the Philadelphia Centennial Exposition in 1876. Corliss was the only manufacturer who dared bid on the invitation to supply so much power.

PROGRESS DURING THE FIRST CENTURY OF THE UNITED STATES OF AMERICA*

DECADE 1 — 1776–1785

The Revolutionary War. • Several ironmasters sign Declaration of Independence. • British burn ironworks at Valley Forge. • Blast furnaces in several Colonies produce cannon and cannon balls. • Some brass cannon manufactured. • Period in which gunsmiths were busy. • First submarine, used in war, built by David Bushnell. • Corps of Engineers, United States Army established. • James Watt patents double-acting steam engine and other important engine devices.

DECADE 2 — 1786–1795

Adoption of United States Constitution. • The first United States Census. • United States Patent Office established. • Eli Whitney invents cotton gin. • Samuel Slater builds first Arkwright cotton machinery in the United States at Pawtucket, R.I. • A breech-loading, flint carbine produced. • First canal in United States built at South Hadley Falls.

DECADE 3 — 1796–1805

Louisiana Purchase. • Lewis and Clark Expedition. • Findley builds the first iron suspension bridge in America at Jacobs Creek, Pa. • John Fitch experiments with screw propeller in New York. • Cast-iron mouldboard plough patented. • The first Fourdrinier papermaking machine turned out. • Library of Congress founded.

DECADE 4 — 1806–1815

War of 1812. • Robert Fulton's steamboat, the *Clermont*, marks the beginning of successful steam navigation. • The first steam ferry boat, designed by John Stevens. • Thomas Pope exhibits model of a wooden arch, of 1600 feet span, across the East River, at site of Brooklyn Bridge. • Patent for splitting leather obtained, greatly increasing production of leather goods. • Steam power successful – used to operate spinning machinery.

DECADE 5 — 1816–1825

Era of Good Feeling. • The Erie Canal built. • Famous crossing of the Atlantic by the *Savannah*, a pioneer attempt, using steam only 80 hours of the 27-day passage (Savannah to Liverpool). • Building of the National Road across Allegheny Mountains to the Ohio River. • First gas company in the United States was incorporated in Baltimore, Md.

DECADE 6 — 1826–1835

Genesis of the American railroad system: Quincy, Mass. – a gravity cable line to bring granite from quarry for Bunker Hill Monument. • At Carbondale, Honesdale, and Mauch Chunk, Pa., cars pulled by gravity or by stationary engines. • The *Tom Thumb* and the *Stourbridge Lion*, operate under their own power. • Beginning of the following present railroads: Baltimore and Ohio; Pennsylvania; New York Central; New York, New Haven and Hartford; Boston and Maine. • Cyrus McCormick patents his first reaper. • Joseph Henry develops the electromagnet. • The friction match invented. • Power printing presses put to use and type composing machine invented by William Church.

DECADE 7 — 1836–1845

Charles Goodyear's discovery of the process of the vulcanization of rubber. • Each using steam throughout the voyage, the *Sirius* and *Great Western* cross Atlantic simultaneously, marking the beginning of transatlantic steam navigation. • Samuel Morse builds the first telegraph line, between Baltimore and Washington. • Bunker Hill Monument completed. • Charles Ellet builds the Fairmount suspension bridge over Schuylkill River. • British patent granted for the first incandescent lamp. • First steam shovel invented by William S. Otis. • Beginnings of photography.

DECADE 8 — 1846–1855

The Mexican War. • Founding of: The Smithsonian Institution; Boston Society of Civil Engineers; American Society of Civil Engineers; American Association for the Advancement of Science. • Gold discovered in California. • The Corliss engine patented. • The sewing machine patented by Elias Howe. • The Otis power elevator exhibited in New York. • John Roebling's Niagara Falls suspension bridge opened to rail traffic. • Bessemer patent for making steel granted, while William Kelly develops similar process. • Construction of Hadley Falls Dam at Holyoke, Mass.

DECADE 9 — 1856–1865

The Civil War. • The first Atlantic cable laid, but soon fails. • Edwin Drake drills first commercial well for petroleum at Titusville, Pa. • Battle of *Monitor* and *Merrimac* marks the end of wooden battleships. • Siemans patent for the regenerative furnace on which open-hearth steel depends. • Many military inventions. • Maiden voyage of the *Great Eastern*, the first "leviathan," an iron ship propelled by screw propeller, paddle wheels, and sails. • Passage of the Homestead Act, stimulating emigration to the Great West. • Charter granted to Massachusetts Institute of Technology.

DECADE 10 — 1866–1875

Purchase of Alaska from Russia. • Establishment of the United States Weather Bureau. • The Atlantic cable successfully laid by the Great Eastern. • Completion of the Pacific Railroad, the first transcontinental line. • James Eads undertakes the improvement of the mouth of the Mississippi River. • Completion of the Eads Bridge at St. Louis. • Foundations and anchors completed and start of cable spinning for the Brooklyn Bridge. • Alexander Bell, on his 29th birthday, receives patent No. 174,465 for the telephone, called the most valuable single patent ever issued. • Thomas Edison (also 29 in 1876) had invented a vote recorder, a printing stock ticker, and other devices. Established at Menlo Park in 1876, he invented the carbon transmitter for Bell's telephone and started to develop automatic telegraphy, the mimeograph, the phonograph, and to improve the typewriter into a practical machine. • George Westinghouse invents air brake. • First commercially successful open-hearth steel plant in America starts construction.

* Every item in this table has been checked against one or more reputable authorities. Since authorities sometimes disagree in establishing dates, the reader will understand why there may be some uncertainty in establishing "first" events. Events listed are not restricted to activities in the United States.

Leslie's Historical Register

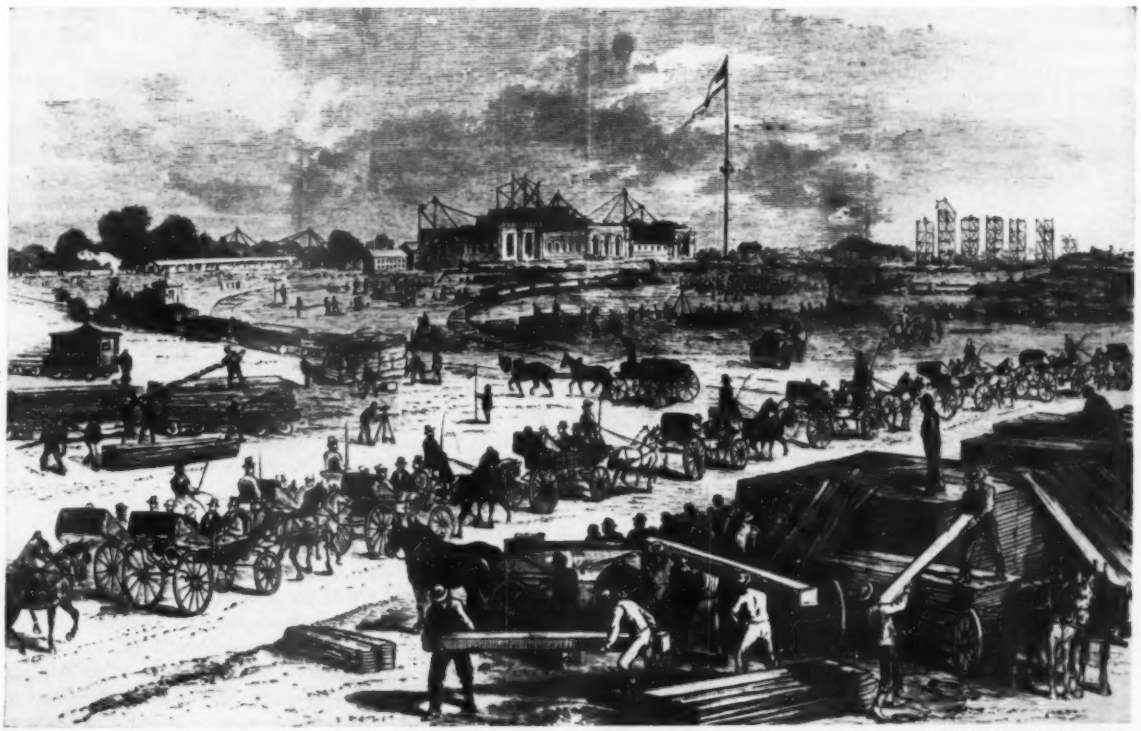
Streetcar accommodations during the Philadelphia Exposition of 1876. Perhaps there are 200 persons on this two-horse streetcar; the horses, therefore, are pulling about 15 tons along the iron rails. It is evident that the two horses in the picture are not happy, and New York observers might call the abuse to the attention of the new Society for the Prevention of Cruelty to Animals, chartered in New York, 10 years previously.

might be expected from a people living in a vast country with large areas still to be developed. Invention, and the science of the period played a major role in the Exposition which, among other things, served to document 10 decades of national existence.

Hero of the day was George H. Corliss, American engineer and designer, and builder of the huge steam engine which was to supply power for the Philadelphia exhibits. Officially, the Exposition opened when Ulysses S. Grant, President of the United States, assisted by Dom Pedro, Emperor of Brazil, turned the crank-handled valves to admit steam to the great Corliss engine. Addressing both of these statesmen, Mr. Corliss merely said: "Are you both ready? Then your Majesty will turn that handle. Now, Mr. President, yours." As President Grant operated the second valve, the huge engine began turning shafting exceeding a mile in length, and thus brought to dynamic life the numerous machines of the Centennial Exposition.

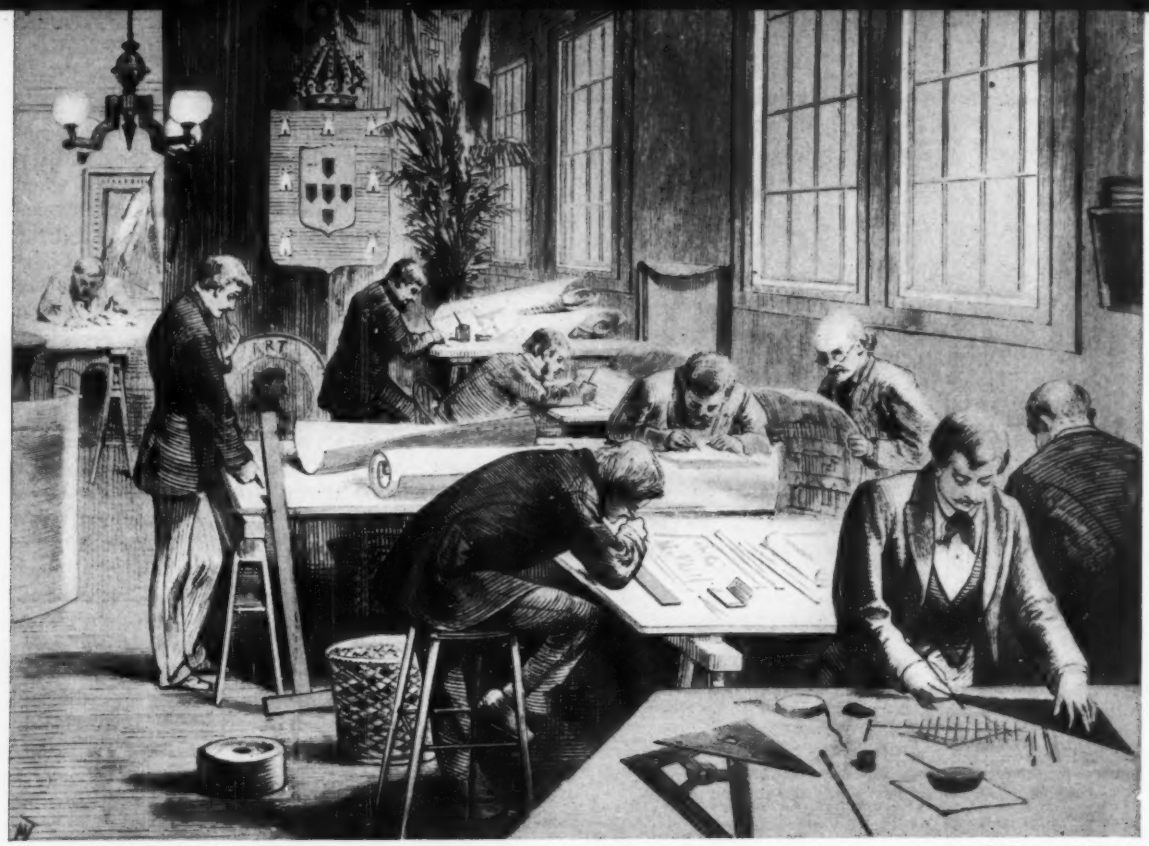
Perhaps it is true that science and invention flourish best in the democratic atmosphere. Certainly the 10 decades from the invention of David Bushnell's first submarine to be used in war, in 1776, to the thrilling demonstration of the vaguely psychic device which its bearded young inventor, Alexander Graham Bell, called the telephone, had been a century prolific in American invention. It was the century of the industrial revolution brought about through invention. The Centennial Exposition itself ushered in a new era of communication when Bell talked to the Brazilian Emperor, Dom Pedro, over a wire at the Exposition.[1]

[1] Bell's account of this momentous incident is recorded in the following words: "I heard afterward . . . that the Emperor held it up in a very indifferent way to his ear, and then suddenly started and said 'My god! it speaks!' . . . Suddenly I heard a noise of people stamping along very heavily, approaching, and there was Dom Pedro, rushing along at a very un-Emperor-like gait, followed by Sir William Thomson and a number of others, to see what I was doing at the other end." *Book of Wonders*, 1916.



Leslie's Historical Register

New York and New England merchants visit the Centennial during construction. This lively construction scene could be modern, except that no steam shovels, no bulldozers, and no trucks are evident, and we might wonder about the horse-drawn carriages and the two laborers who carry a 1,000-pound timber with ease.



Leslie's Historical Register

Architects of the Centennial Buildings. With the deletion of the gas chandelier and a few whiskers, this becomes a modern drafting-room scene.

Novel ideas, Gargantuan exhibits, and vast areas of display at the Exposition made a profound impact on American life. American men measured the past success in the development of the resources of the country against their apparently unlimited extent, and were inspired toward even greater successes. Historians agree; the Centennial Exposition of 1876 was an outstanding landmark in the story of American progress.

Leslie's Historical Register

Japanese workmen lay the foundation for the Japanese Building. By one account, the appropriation of Japan for the Exposition greatly exceeded that of any other foreign nation.

Spirit of (18)76

The contemporary pictures by Currier and Ives reveal the styles of the men and women of the post-Civil War era; how they got about by land or sea, and their interests. Socially and politically this era was a time of strong contrasts. While the famous evangelists, Moody and Sankey, helped pious thousands by their sincere eloquence in words and song, there were many spiritualistic mediums, who played on the yearnings of those who had lost sons or husbands in the terrible war but recently ended. The northern carpetbaggers and southern scalawags hindered the efforts of able statesmen of both North and South as they endeavored to solve the heartbreaking problems of reconstruction, engendered by the war. Brilliant industrialists and engineers, who planned the development of the American Great West, had to compete with the dishonest promoters of phantom mines and railroads that would never operate. Peculiar, also, by the standards of today, were the styles of the Centennial year. These are revealed by contemporary advertisements.

"Whiskers! How to grow a thick and heavy Beard on the smoothest face in six weeks. Particulars free. Southwestern Agency, Carthage, Mo."[2] "The Standard Lotta Bustle . . . the lightest, strongest, most durable comfortable elastic and cheapest bustle in the market. The wearer can sit in any position whatever without bending or injuring it in the slightest degree, it clos-

(*Continued on page 530*)

[2] Advertisement in *Harper's Weekly*, 1873.

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Alumni Day, 1949

SATURDAY, June 11, has been designated as Alumni Day, 1949, when former students will return to Cambridge to participate in a program of events at M.I.T. This year's agenda will differ somewhat from that of previous years in eliminating the symposium because of the extensive program of scholarly papers which was presented during the Convocation. But otherwise the day's events, including the popular Stein-on-the-Table Banquet, will be in keeping with tradition.

In the morning, groups will visit Faculty members or take part in organized tours which will include the new supersonic wind tunnel, the 350-million electron-volt synchrotron, the Gas Turbine Laboratory, and the exhibition of modern aircraft and automotive engines in the Sloan Automotive Laboratory. Motion pictures of "M.I.T. in Action" and of the Convocation and Inauguration will be shown. Visitors will also have opportunity to see new construction going up (or recently completed), including the Rockwell Athletic Cage, the Charles Hayden Memorial Library, and the Eastgate apartment building. At noon, there will be the traditional open-air alumni luncheon in Du Pont Court.

During the afternoon, visitors will have opportunity to attend a tea and take part in the formal opening of the new Senior House. Dr. and Mrs. Compton and President and Mrs. Killian will receive at the tea.

Classes will convene for informal gatherings at the Hotel Statler, between 5:30 and 6:30 P.M., prior to the famed annual Alumni Banquet. At the traditional Stein-on-the-Table Banquet, Alumni will be privileged to hear addresses by Karl T. Compton, chairman of the Corporation, and President Killian.

To Office

BALLOTS, on which members of the Alumni Association voted for new officers to serve for the coming year, were closed on April 25. Tabulation of results showed that 2,763 ballots were properly cast, resulting in the election of: C. Adrian Sawyer, Jr., '02, as President of the M.I.T. Alumni Association for one year; Horatio L. Bond, '23, Vice-president for two years; and Philip E. Morrill, '14, and Parke D. Appel, '22, to serve on the Executive Committee, each for a two-year term.

Also elected as term members on the Corporation for five-year terms were: Rudolf F. Haffenreffer, '95, Robert T. Haslam, '11, and George J. Leness, '26. Luis de Florez, '11, was also elected to serve as term member on the Corporation to fill the vacancy of the late Albert J. Browning, '22.

Ballots for the National Nominating Committee showed that the following men were elected: *District 1* – H. B. Richmond, '14; *District 2* – Harold C. Pearson, '23; *District 4* – Donald B. Webster, '16; *District 5* – Winfield I. McNeill, '17.

Class Reunions

The following information is the latest which has been received from class secretaries and reunion chairmen concerning reunion plans and get-togethers which are to be held in 1949.

1884 June 11, Alumni Day. 65th anniversary. Luncheon in Du Pont Court.

1893 June 9. Annual meeting and luncheon at Engineers Club, 96 Beacon Street, Boston.

1894 June 10 and 11. June 10 at Braeburn Country Club, Newton; June 11, special Class table at Alumni Day luncheon, Du Pont Court. Details in Class letter.

1899 June 9–11. 50th reunion. June 9, luncheon, The Country Club, Brookline; dinner, Hotel Sheraton, Boston. Participation in commencement activities. June 11, special Class table at Alumni Day luncheon, Du Pont Court.

1903 Informal reunion in Boston vicinity.

1904 June 24–26, East Bay Lodge, Osterville, Mass. Carle R. Hayward and Eugene H. Russell, Jr., in charge of plans.

1907 June 24–26, Oyster Harbors Club, Osterville. From Friday afternoon until Sunday afternoon.

1909 June 17–19. Friday afternoon through Sunday. East Bay Lodge, Osterville. Accommodations available for anyone who wishes to come earlier or stay later.

1912 June 10–12. New Ocean House, Swampscott, Mass. Albion R. Davis in charge.

1914 June 17–19, Sheldon House, Pine Orchard, Conn. Reunion chairman, Charles P. Fiske.

1919 June 24–26, Norwich Inn, Norwich, Conn. Reunion chairman, Wilfred O. Langille, Diehl Manufacturing Company, Somerville, N.J.

1924 June 8–11, East Bay Lodge, Osterville. George E. Parker, reunion chairman.

1929 June 12–14, Sunday afternoon to Tuesday morning. East Bay Lodge, Osterville. John J. Wilson, Jr., chairman, 255 Beacon Street, Apartment 54, Boston 16.

1934 June 9–11, Ye Castle Inn, Cornfield Point, Saybrook, Conn. June 9, informal supper; June 10, Class banquet; June 11, program ends after breakfast.

1939 June 17 and 18, Mayflower Hotel, Plymouth. Frederick B. Grant, 22 Edmunds Road, Wellesley Hills 82, Mass., in charge of plans.

1944–2 June 10, The Graduate House, M.I.T., Cambridge. Dinner in the Campus Room. Malcolm G. Kispert, Room 3-208, M.I.T., in charge of plans.

1944–10 June 10, Hotel Sheraton, Boston. Dinner in private dining room. James B. Angell, M.I.T. Graduate House, in charge of plans.

Please consult your class secretary for more detailed information which may be available.

Stratton Appointed Provost

JULIUS A. STRATTON, '23, Professor of Physics and Director of the Research Laboratory of Electronics, has been appointed provost of the Institute. The academic post of provost is a new one at M.I.T., and Dr. Stratton, whose appointment became effective on April 15, will share with the president and the deans the administrative direction of the Institute's educational program. In announcing the appointment of Dr. Stratton, President Killian said:

The Corporation and my associates in the Institute's administration feel that Professor Stratton is ideally qualified for educational administration. His background both in electrical engineering and in physics, his brilliant direction of the Research Laboratory of Electronics, and his membership on the Institute's Committee on Educational Survey have provided him with an extraordinarily rich background for his new responsibilities. To all of his many assignments at the Institute he has brought a depth of understanding of education and of research which will be of inestimable value to our over-all program. I am personally delighted and reassured to have him as an administrative colleague and to have available his wise and judicial counsel in discharging my own duties as president.

Dr. Stratton's primary concern will be the administration of educational activities which do not fall within the jurisdiction of any single school, and the co-ordination, in concert with the deans, of interschool educational and research activities.

The officers of the Institute who report to the provost are the director of the Division of Industrial Cooperation, the registrar, the director of Admissions, and the director of the Summer Session. The provost will also have the responsibility for co-ordinating the programs of the large interdepartmental laboratories, which break across the lines of both departments and schools.

In 1919 Dr. Stratton entered the University of Washington, transferring a year later to M.I.T. from which he received the degree of bachelor of science in 1923 and his master's degree in science in 1926. In 1927 he was awarded the degree of doctor of science from the Technische Hochschule in Zurich. For the next year he studied in Europe under a traveling fellowship from M.I.T., principally at the universities of Munich and Leipzig.

In 1924 he was appointed a research assistant and in 1928 he was made an assistant professor in the Department of Electrical Engineering. He transferred to the Department of Physics in 1930. In 1935, he was promoted to the rank of associate professor of physics, and became a full professor in 1941.

From 1940 to 1945 Dr. Stratton was a member of the staff of the Radiation Laboratory at the Institute. During World War II he was also an expert consultant in the office of the Secretary of War. It was for his outstanding services there that Dr. Stratton was awarded the Medal for Merit from the Secretary of War in 1946.

Upon his return to M.I.T. in 1944, Dr. Stratton was active in the organization of the Research Laboratory of Electronics of which he became director that same year. He served from 1946 until January, 1949, as chairman of the Committee on Electronics of the Joint Research and Development Board.

Sound Advice

IN the absence of President Dandrow, John A. Lunn, '17, Vice-president of the Alumni Association, presided at the 268th meeting of the Alumni Council which was held at the Graduate House on April 25.

During the business portion of the meeting it was reported that nine members of the Institute staff had visited 14 clubs between March 2 and April 25. Henry B. Kane, '24, Director of the Alumni Fund, reported that the ninth year of the Fund had closed on March 31 with a total of $152,502.07 contributed by 9,963 Alumni – representing an increase of about 200 contributors over the previous year.

Malcolm G. Kispert, 2–44, was then called upon to present a report from the President's Office on current developments at M.I.T. His remarks were concerned primarily with the beneficial results which followed the Convocation and Inauguration as reported in the May issue of The Review. Mr. Kispert also read a statement prepared by President Killian (as published on page 432 of the May issue of The Review) on Institute policy on matters of academic freedom.

Mr. Lunn then introduced Professor Richard H. Bolt, Director of the Acoustics Laboratory, who discussed recent problems and developments in the field of acoustics. His talk, which was illustrated with slides, gave particular emphasis to work being done at the Institute on the topics of studio design and construction, studies in aircraft acoustics, research on chemical and physical properties of such substances as rubber, and the development of new building materials, such as concrete blocks and wall panels.

M.I.T. Photo

Julius A. Stratton, '23
Provost of the Institute

Norman Levinson, '33
Professor of Mathematics

Gyorgy Kepes
Professor of Visual Design
(top left)

Charles A. Myers
Professor of Industrial Relations
(top right)

Samuel C. Collins
Professor of Mechanical Engineering

Eric Reissner, '38
Professor of Mathematics

M.I.T. Photos

Achievement Recognized

PROMOTIONS on the Faculty of M.I.T., as announced in April by James R. Killian, Jr., '26, President of the Institute, included 5 to the position of professor, 10 to associate professor, 18 to assistant professor, and 17 to instructor in the annual list of advancements of the Institute's Faculty.

Advanced to the rank of full professor were: Gyorgy Kepes, School of Architecture; Charles A. Myers, Department of Economics and Social Science; Norman Levinson, '33, and Eric Reissner, '38, Department of Mathematics; and Samuel C. Collins, Department of Mechanical Engineering.

Assistant professors who have been promoted to the rank of associate professor were: Robert C. Seamans, Jr., '42, Department of Aeronautical Engineering; Harold S. Mickley, 2–46, Department of Chemical Engineering; John C. Sheehan, Department of Chemistry; James W. Daily, Department of Civil and Sanitary Engineering; Elting E. Morison, Department of English and History; Milton C. Shaw, and Joseph Kaye, '34, Department of Mechanical Engineering; and George E. Valley, Jr., '35, Sanborn C. Brown, 10–44, and Martin Deutsch, '37, Department of Physics.

Promotions to the rank of assistant professor were: Michael Witunski, '43, and Dominic Amara, 9–46, Department of Aeronautical Engineering; John J. Mealy, Director of the Bangor Station, School of Chemical Engineering Practice; David A. Trageser, 6–45, Director of the Buffalo Station, School of Chemical Engineering Practice; Kevin A. Lynch, '47, Department of City and Regional Planning; Thomas W. Lambe, '44 and J. Melvin Biggs, '41, the Department of Civil and Sanitary Engineering; George P. Shultz, Department of Economics and Social Science; George C. Newton, Jr., '41, Samuel J. Mason, '47, Wilbur B. Davenport, Jr., '43, John G. Linvill, '43, and William K. Linvill, 6–45, Department of Electrical Engineering; Theodore Wood, Jr., and David A. Dudley, Department of English and History; Kenneth R. Wadleigh, '43, Department of Mechanical Engineering; Maurice E. Shank, Department of Metallurgy; and Abdul J. Abdullah, 6–46, Department of Meteorology.

Members of the staff to become instructors are: Albert J. O'Neill, '32, Dimitrios (James) A. Polychrone, '47, and Thomas A. Hood, 6–45, Department of Building Engineering and Construction; Raymond F. Baddour, Assistant Director, Oak Ridge Engineering Practice School; Harl P. Alrich, Jr., '47, Department of

Civil and Sanitary Engineering; George B. Baldwin, 2–44, Department of Economics and Social Science; John C. Löf, '41, David C. Whipple, Joseph K. Dillard, Monir A. Kashmiry, Richard B. Adler, '43, Carroll E. Frank, Vinton B. Haas, Jr., Harold M. Lucal, and Denis U. Noiseux, 9–46, Department of Electrical Engineering; Richard B. Palme, Department of Mechanical Engineering; and Eugene S. Pulk, '43, Department of Meteorology.

M.I.T. to Award New Degree

FOR practicing engineers a new terminal degree, to be called the "Engineer" degree, has been approved at the Institute and is expected to be awarded for the first time at Technology's commencement this June, according to John W. M. Bunker, Dean of the Graduate School. The degree "Engineer," with the field of specialization designated, will require about two years' study following a bachelor's degree in any one of the Institute's various engineering departments. Said Dean Bunker:

> The new degree fills an educational need for the development of professional engineering competence at a higher level than is ordinarily represented by the master of science degree.
>
> The expansion of scientific knowledge which can be applied in several areas of engineering practice has been so extensive that a specialist in any one field needs to achieve more than casual acquaintance with related fields if he is to render the most effective service in engineering.
>
> With the establishment of the Engineer degree as a terminal degree for those who will practice engineering, the Ph.D. and Sc.D. degrees will continue to be the objective for those who have interest in and aptitude for original, creative research.

The new degree will be recommended for students who complete an individually planned, two-year program of study and research at the Institute beyond their undergraduate degrees. Emphasis will be placed upon engineering practice, rather than on the research which is characteristic of a program of study leading to a Ph.D. degree.

Most candidates for the master's degree at the Institute require slightly more than one year of study to complete their work; candidates for the new degree, Engineer, will require at least two years at the Institute. This added time will result in more thorough training in a wider variety of relevant subjects, and also will enable students to delve more extensively into such fields as industrial economics, business administration, labor relations, and international affairs, thus improving their understanding of the social implications of the work in which they will be engaged.

When the field of specialization is to be indicated, the Engineer degree will be referred to as follows: Civil Engineer, Mechanical Engineer, Metallurgical Engineer, Electrical Engineer, Chemical Engineer, Sanitary Engineer, Marine Mechanical Engineer, Naval Architect, Naval Engineer, Aeronautical Engineer, Building Engineer, and Meteorologist.

The new degree will be conferred for the first time at the June, 1949, commencement exercises when three dozen candidates will become Engineers.

Toward Broader Engineering Training

POMONA College of California and Wesleyan University in Connecticut have joined the Institute's plan offering a combined course of study in the liberal arts and in technology, President Killian recently announced. The combined plan of study now includes 14 liberal arts colleges, all of which cooperate with M.I.T., under a plan jointly established in 1936, in organizing an effective combination of liberal arts and specialized technological training at the undergraduate level. Such a program provides a broadened training for those whose major interest may be in the fields of science, architecture, or engineering.

Under the arrangement, students of high academic standing may pursue a specially planned course for three years in any of the participating liberal arts colleges and then complete the requirements for a science, engineering, or city planning degree in two years at the Institute. A degree in architecture requires three years' additional study at M.I.T. Both a B.S. degree from the Institute and a B.A. degree from the liberal arts college are awarded on completion of the program. In announcing the additional acceptances, Dr. Killian said:

> Many prospective students of engineering, science, architecture, or city planning wish to attend a liberal arts college before undertaking their professional training. The combined plan is designed to make this possible without the time and expense which would be required if two entirely independent curricula were to be followed.
>
> At least one year of time is saved in the combined plan of study, and the degrees of both institutions and the broadening advantages of residence in both are secured. This combined plan is a fine demonstration of collaboration among colleges and of combining liberal arts with technological education.
>
> The background contributed by liberal arts colleges is of great help to the Institute in meeting its responsibilities for its students' effectiveness as individuals and citizens as well as their technological competence.
>
> We are gratified to have this program of combined studies extended to two additional colleges, and we are confident of their contributions through this cooperative plan.

Other colleges participating in the combined plan include: Amherst College, Amherst, Mass.; Bowdoin College, Brunswick, Maine; Miami University, Oxford, Ohio; Middlebury College, Middlebury, Vt.; Ohio Wesleyan University, Delaware, Ohio; Reed College, Portland, Ore.; Ripon College, Ripon, Wis.; St. Lawrence University, Canton, N.Y.; Washington and Jefferson College, Washington, Pa.; College of William and Mary, Williamsburg, Va.; Williams College, Williamstown, Mass.; and College of Wooster, Wooster, Ohio.

Since the combined plan of study has been in effect, 56 students have been graduated from M.I.T. under its provisions, according to Professor B. Alden Thresher, '20, Director of Admissions at the Institute. There are now 63 students at M.I.T. under the combined plan, 34 of whom entered last fall. About 75 are expected to enter the Institute in the fall of 1949, Professor Thresher said.

(*Continued on page 520*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

There are many common objects which we all see almost daily. Because they are so familiar we take it for granted that they have reached final perfection. Frequently, however, this is far from being the case. An example can be found in the 2½ gallon fire extinguisher, found for years in almost every factory, school, and office. Countless fires have been put out with it, and lives, buildings, jobs, money saved. Some time ago an important maker of this type of bottom-up extinguisher decided that the latest technological developments should be put to work in both the production and design of this important device. To this end, a complete restudy of possible machines, manufacturing methods, materials, and design was ordered.

These extinguishers for many years had been made largely by riveting, and soldering was used to produce tight seams. There was much hand work, which it would be desirable to reduce. Modern seam-welding techniques seemed indicated, plus mechanization of other steps, and an increased use of conveyor systems. Such an extensive program as this required careful consideration of the relationships among design, materials, methods and machines. It was early decided to switch from the traditional copper to the newer and much stronger silicon bronze, which can be resistance-welded easily. The maker and Revere collaborated closely, and jointly worked out the time, temperature and pressure requirements for clean, sound welds. Revere also established the proper tempers for the body sheet so that it withstands more than the Underwriters' test pressure, but nevertheless is easily formable into a cylinder with beads that locate the top and bottom domes. Similar specifications were written for the sheet to be drawn into those domes, and even their design was studied and recommendations made. The extinguisher manufacturer, for his part, either disposed of old machines, or rebuilt them, and in addition bought much new equipment, some of it on special order.

This program involved one of the most complete renovations of plant and product which Revere has ever observed, and Revere considers itself fortunate to have been permitted to collaborate so closely. We were able to place at the service of our customer the accumulated knowledge of our Technical Advisors, the welding section of the Research Department and in addition called upon three of the Revere mills for practical suggestions. Revere's final step came when a number of the first extinguishers off the production line were tested in the Research Laboratory to make sure that the recommended annealing practices were adequate.

The report given here is necessarily condensed. Actually, the work occupied many months, and included a large number of conferences, much correspondence, and thorough testing of methods. That it all was supremely successful is shown by the results: a fire extinguisher that is 4½ pounds lighter, greatly improved in appearance and design, and produced with greater speed and economy.

This outstanding example of the benefits received when a manufacturer and a supplier collaborate closely is not unique. A pooling of knowledge toward a common end goes on constantly in every industry. Revere suggests, therefore, that no matter what it is you buy, you give your suppliers the opportunity to give you their experience as well as sell you their materials.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

☆ ☆ ☆

Executive Offices:

230 Park Avenue, New York 17, N. Y.

THE INSTITUTE GAZETTE

(*Continued from page 518*)

Electronics Laboratory Advancements

PROFESSOR Albert G. Hill has been appointed director, and Jerome B. Wiesner, Associate Professor of Electrical Engineering, has been made associate director of the Research Laboratory of Electronics at M.I.T., President Killian announced in a recent statement. Professor Hill, who has been associate director of the laboratory, succeeds Professor Julius A. Stratton, '23, whose appointment as provost of the Institute is reported in this issue. Professor Wiesner has been assistant director.

Born in 1910, Professor Hill received the degree of bachelor of science from Washington University in 1930. After two years as engineer with the Bell Telephone Laboratories, he returned to Washington University for the master's degree, awarded in 1934. Professor Hill holds the doctor of philosophy degree in physics from the University of Rochester, where he was a fellow from 1934–1937. He came to M.I.T. in 1937 as instructor in the Department of Physics and in 1941 became a physicist on the staff of the Research Corporation in Los Angeles.

Professor Hill joined the Radiation Laboratory staff at M.I.T. in 1942, first as associate leader and later as leader of the radio-frequency components group. In 1945 he became head of the transmitter components division, the laboratory's largest technical division. In 1946, Dr. Hill was named associate director of the Research Laboratory of Electronics and associate professor of physics at the Institute. In 1947 he became professor of physics.

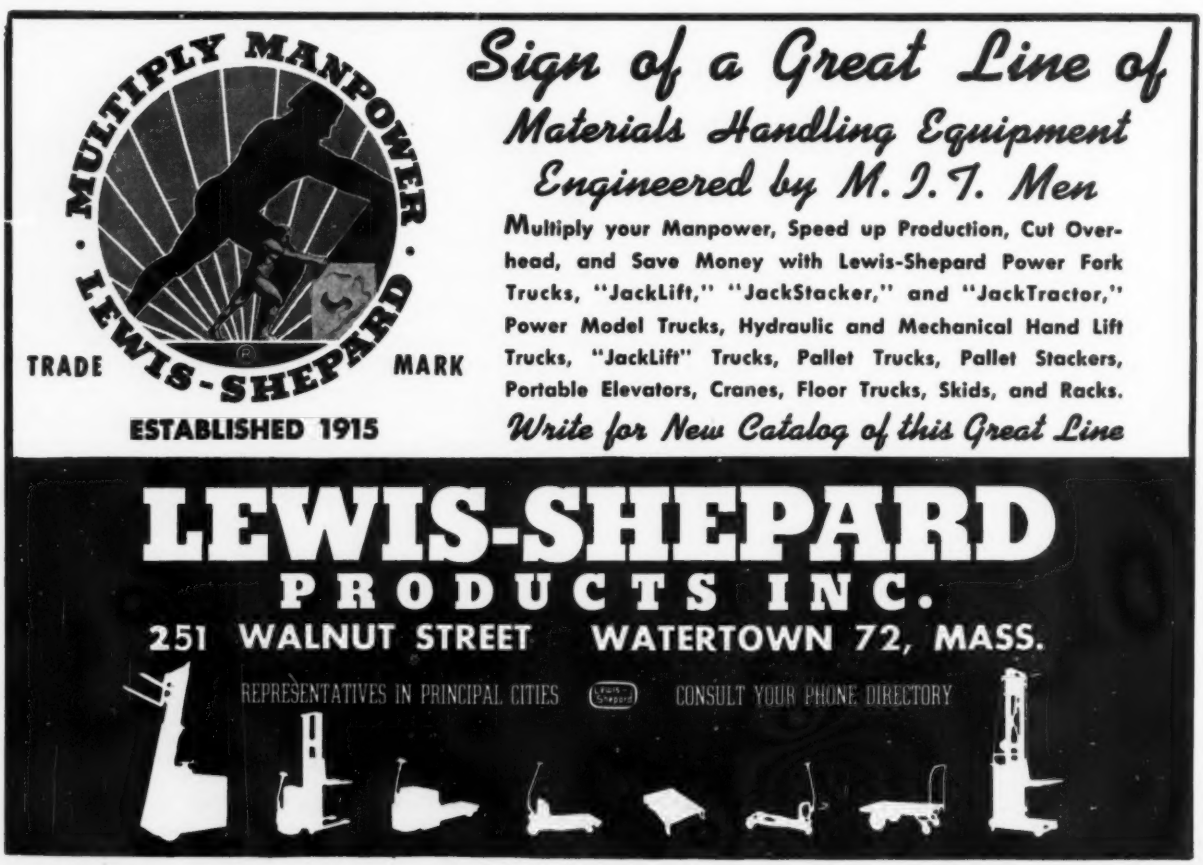
As chairman of the Basic Research Panel of the Research and Development Board of the National Military Establishment, Dr. Hill is an expert consultant to the Secretary of Defense. He is a fellow of the American Physical Society.

Professor Wiesner was born in 1915 in Detroit, Mich., and attended the University of Michigan, from which he received the bachelor of science and master of science degrees in 1937 and 1938, respectively. In 1938 Professor Wiesner was appointed chief engineer of the Acoustical and Record Laboratory in the Library of Congress, Washington, D.C. Here, under a Carnegie Foundation grant, he assisted in developing sound-recording facilities and associated equipment.

Shortly after the beginning of World War II, Professor Wiesner came to the Radiation Laboratory at the Institute and became a member of the laboratory's Steering Committee. When released from the Radiation Laboratory, Professor Wiesner joined the Faculty of the Institute as assistant professor of electrical engineering in 1946. In 1947 he became associate professor and assistant director of the Research Laboratory of Electronics.

The M.I.T. Research Laboratory of Electronics was organized in 1946 as a joint project of the Departments

(*Concluded on page 522*)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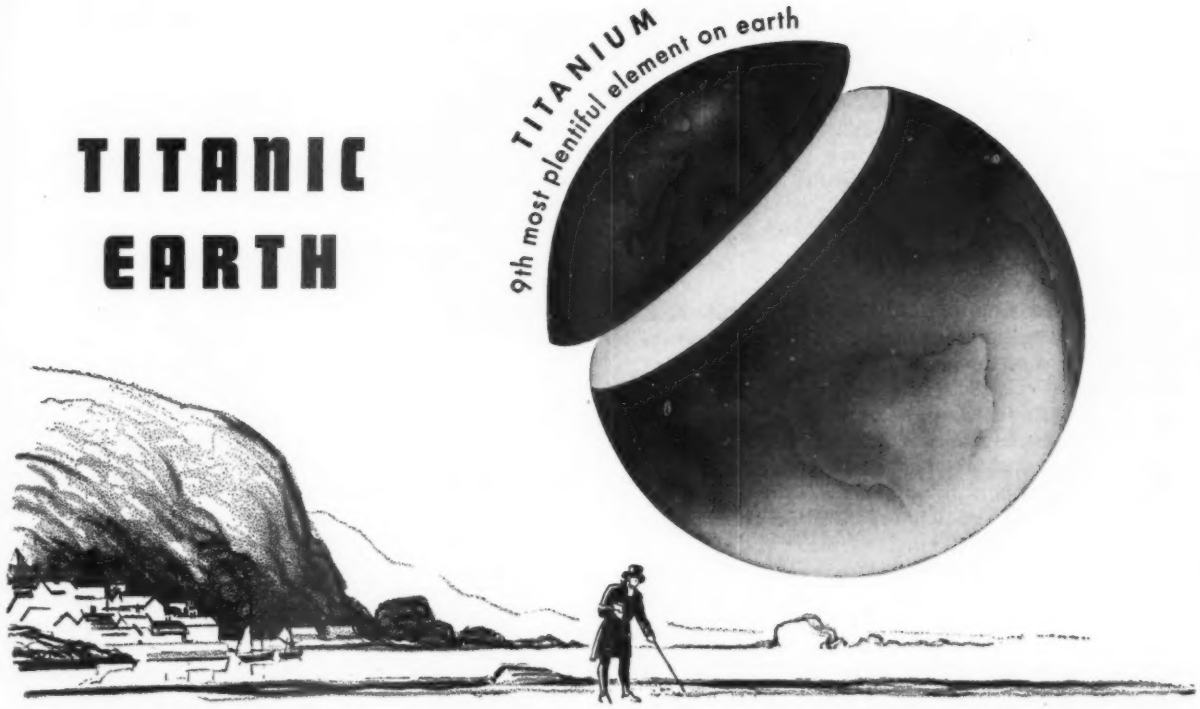

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Back in 1791 an English clergyman, William Gregor, who liked to stroll and think on the beaches of Cornwall, became curious about the black sand he saw there. This gentleman of the cloth was also an amateur chemist and in this sand he discovered a new element. Almost coincidentally an Austrian named Heinrich Klaproth (also discoverer of uranium and zirconium) extracted the same thing from rutile and named it "Titanic Earth" for the mythical Titans. Hence our name Titanium.

Thereafter titanium was found in various places including the Ilmen Mountains of Russia (ilmenite) but although it is the ninth element in order of earthly abundance, it remained a mere laboratory curiosity until 1908.

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At that time Dr. A. J. Rossi, expert in the reduction of metals, mixed titanium oxide with salad oil to make a white paint. In another 10 years a pure oxide was being produced which quickly won success as a pigment. Paint, false teeth, face powder, tires, shoes, glassware, textiles, inks, plastics, paper consumed an increasing tonnage of titanium oxide but still the pure metal was beyond industry's reach.

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Only by exclusion of these gases can it be kept from embrittling combinations and when Remington Arms Company, a Du Pont subsidiary, laid its plans to produce metallic titanium in cast and rolled shapes, they knew that at National Research Corporation they could find the knowledge of vacuum technique that they needed.

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THE INSTITUTE GAZETTE

(*Concluded from page 520*)

of Physics and Electrical Engineering. The laboratory has become the nucleus of research activities in electronics for all members of the Institute's Faculty, and is an important center of graduate training in this promising field.

Open Door

THE Executive Committee of the M.I.T. Corporation will waive tuition fees for a number of European displaced persons to enable them to study at the Institute during the 1949–1950 school year. Not more than 10 such students will be accepted. They will be classified as special students at M.I.T. and will attend regular classes and take part in all student activities.

The displaced persons students, who will be sponsored at M.I.T. by a student organization, will be part of a group of several hundred who will study at United States colleges and universities next year through arrangements being made by the National Student Association and the World Student Service Fund. Herbert W. Eisenberg, of the Class of 1951, is chairman of the student committee which will sponsor this group of European students at the Institute. Final selection of those students who will come to M.I.T. is to be made by admissions officers of the Institute, after studying recommendations from officials of international relief agencies in Europe.

THE WHITE-COLLAR WORKER

(*Continued from page 510*)

Their poll responses reveal a very interesting set of reactions to unions. On two different occasions they displayed a rather strong belief in labor unions: 69 per cent in November, 1941, and in May, 1942, "favored" labor unions. On other union questions they are not always so sympathetic. Four out of five during the days of the National Defense program (June, 1941) felt that labor unions were not helping that program as much as they should. In May, 1943, almost two-thirds felt that shop foremen should not become unionists. In the case of questions involving congressional legislation forbidding strikes in defense or public service industries (in November, 1941, and April, 1947) they would give the government that authority (72 per cent and 59 per cent). However, in August, 1947, they held (65 per cent) that workers should have the right to go on strike.

Poll data seem to show that white-collar thinking crystallizes along the pattern of the country as a whole. There is less opposition to, and greater acceptance of, the labor movement – a tendency which needs observation and study.

The blandishments of union organizers have wooed thousands of white-collar workers into union ranks. There can be no doubt that, to the labor movement, the white-collar force is a sizable, almost uncourted throng. What, then, is the outlook for unionization of

(*Continued on page 524*)

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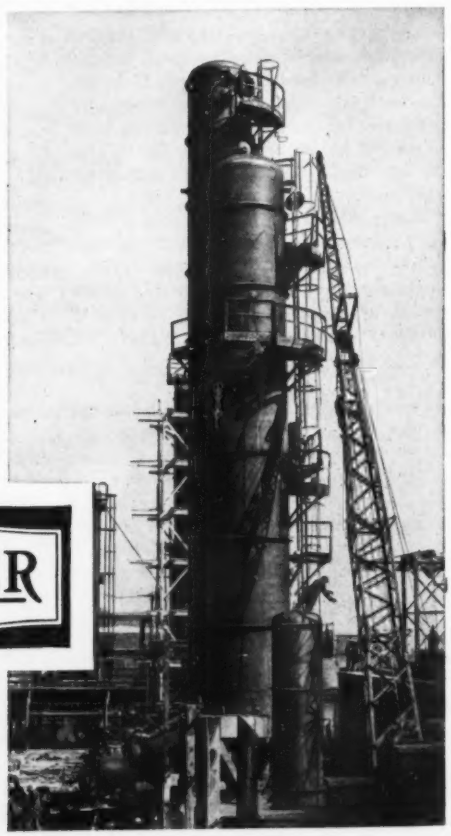

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THE WHITE-COLLAR WORKER

(Continued from page 522)

the increasingly numerous white-collar class of people?

At the present time the prospect seems to be defined by arguments which may be entered on both sides of the ledger. Office and sales unionization is encouraged, for example, by price and income conditions. White-collar salaries have not kept pace with plant wages, or with cost-of-living increases. During the war years, for instance, weekly salaries for other groups increased three times greater than for this group; the pattern has not changed since then. Henry L. Wylie, in an address before the National Office Management Association convention two years ago, mentioned other factors creating union sympathies among these employees.[12] They are finding that many advantages almost exclusively enjoyed by themselves – paid sick leave, for example – are now being given to factory workers. Salaries for the same positions in offices and sales rooms are not uniform. Job-placement policies of management which fail to utilize the highest skill of an employee have nettled them. The lack of grievance machinery and of methods of exploring and recognizing personnel needs have added to their discontent. Managerial overemphasis on the productive responsibilities of supervisors and the consequent neglect of skills for dealing with emotional problems belong in this picture of white-collar restlessness. A minor influence has been an unanticipated reaction to the Taft-Hartley law which, outlawing some of the more reprehensible union tactics, gave

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unionism "a new look" of respectability to the labor force in the front offices. The fast-growing mechanization of the office and sales room may prove to be a very decisive factor in the emergence of a white-collar labor movement.

In the long run, these developments may not prove sufficient to overcome certain traditional handicaps confronting the union organizer in this field. Union campaigns, for example, have collided constantly with a white-collar psychology that identifies them with the management area of business and industry. This psychology has been reinforced by an educational background and work situation characteristically "individualistic," just as it has been supported by the prestigious status supposedly attached to white-collar routines. Promotion to management from white-collar ranks – not as frequent as formerly, to be sure – occurs often enough to keep the mythology of vertical mobility alive. Marital ambitions and status which maintain a high turnover in this field likewise create, among women workers of course, a certain immunity to union propaganda. Like most workers, these employees show signs of a fear of the boss, a very efficient antidote to unionism, temporarily at least.

However weighty these arguments may in time prove to be, the fact is that white-collar unionization is progressing. Robert K. Burns, of the Industrial Relations Center, University of Chicago, in a recent news release has called attention to the deep inroads made by the organized labor movement into certain white-collar employments. Greatest success has been

(*Continued on page 526*)

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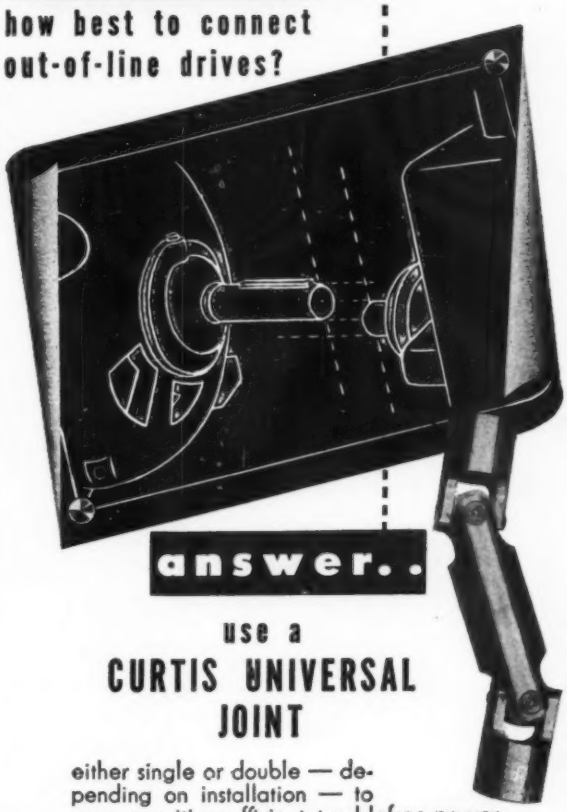

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THE WHITE-COLLAR WORKER

(Continued from page 525)

achieved among these workers in the railroad industry, in the communications industries (where one in every three of them is a union member), and in public utilities. Petroleum, movies, securities, and insurance, along with government service, appear to be among the fertile fields.[13]

The United Office and Professional Workers, an affiliate of the Congress of Industrial Organization, is the largest specialized white-collar union. Next in size is the American Federation of Labor's Office Employes' International Union, which has reported successes in the public utilities offices. There are two independent national unions, the National Federation of Salaried Workers and the Communications Workers of America. Some of the older production workers' unions have arrangements for the inclusion of white-collar employees: the International Association of Machinists, the Electrical Workers Union, the Chemical Workers, the Hotel and Restaurant Workers, the United Auto Workers, the United Steelworkers, and the Industrial Union of Marine and Shipbuilding Workers. The most extensive study[14] to date of collective bargaining by white-collar workers has concluded that: "Unions are still struggling for a foothold in the office, concentrating on basic contract provisions like union security, salaries, seniority, and protection against layoffs and dismissals."

(Concluded on page 528)

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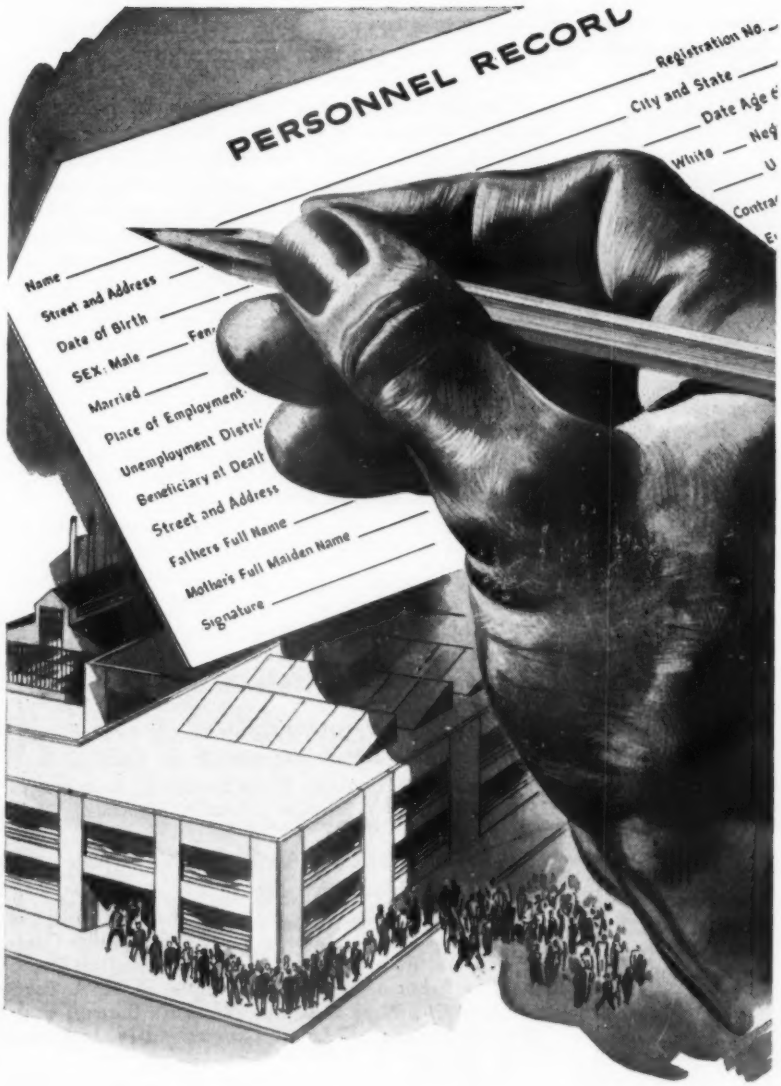

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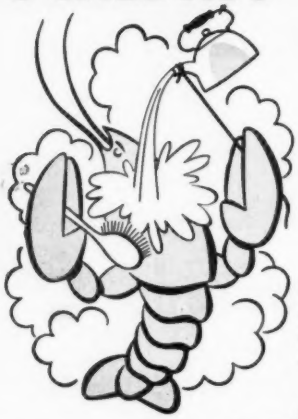

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THE WHITE-COLLAR WORKER

(Concluded from page 526)

Whatever management attitudes and policies towards white-collar workers may have been or may be in the future, it should be clear that office and sales management cannot succeed where factory management failed: unionism flourishes upon outmoded and ill-considered personnel policies.[15] The labor movement and management lose effective leaders and members when large groups are discouraged from identifying themselves with either group. Proximity to, and even participation in, management functions do not necessarily make workers management-minded.

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[6] Cf. Grace L. Coyle, *Present Trends in the Clerical Occupations* (New York: Woman's Press, 1928).

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[10] These generalizations are based on 1940 Census data. Additional social data may be derived from other Census reports and from excellent studies published by Department of Labor agencies. For example, cf. H. A. Byrne, *Women Who Work in Offices* (Women's Bureau, United States Department of Labor, Government Printing Office, 1935, Bulletin No. 132).

[11] All references to opinion polls are to issues of *Public Opinion Quarterly*, which reports fully on them.

[12] "The Outlook for Office Unionization," *The Management Review* (April, 1947), **36**:187 and following.

[13] "A Union Target: The White-Collar Worker," *Business Week*, February 7, 1948, pages 88 and following.

[14] Eileen Ahern, *Status of Collective Bargaining in the Office* (New York: American Management Association, 1948).

[15] David Mack, "Office Unionization," *The Management Review* (April, 1948), **37**:181 and following.

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(*Continued from page 514*)

ing entirely upon sitting and returning with precision to the original shape on arising."[2] Thus, stylish men and women adorned their apposite ends in the Centennial year.

Politically, there was the not uncommon contrast between the headlined knaveries of certain politicians in the high places with the underlying honesty of the citizen at his lathe or desk. In the closing month of the Exposition, America's prince of political thieves was jailed: William Marcy Tweed. Black Friday, the day of the panic caused by the attempt of Jim Fisk and Jay Gould to corner the gold market, was now a seven-year-old memory. The recent investigation of the Credit Mobilier of America, which questioned whether high-ranking politicians had accepted stock in the Pacific railroads in return for votes, had kindly cleared most of them; but its disclosures were still a poignant memory. On the surface, the decade between 1865 and 1875 appeared to be marked by a scarlet record of low moral standards, with vultures of finance feeding upon the avarice of thousands who hoped to get rich overnight. At least such is the conclusion if we can accept as accurate the popular contemporary novel of Mark Twain and Charles Dudley Warner:[3] *The Gilded Age*. The Exposition closed within a few days of the election that was to have decided who should succeed General Grant as President of the United States; but several months were to elapse before the Electoral Commission was to decide that Rutherford B. Hayes, not Samuel J. Tilden, should be declared elected. Here, too, appeared strong evidence of political maneuvering.[4]

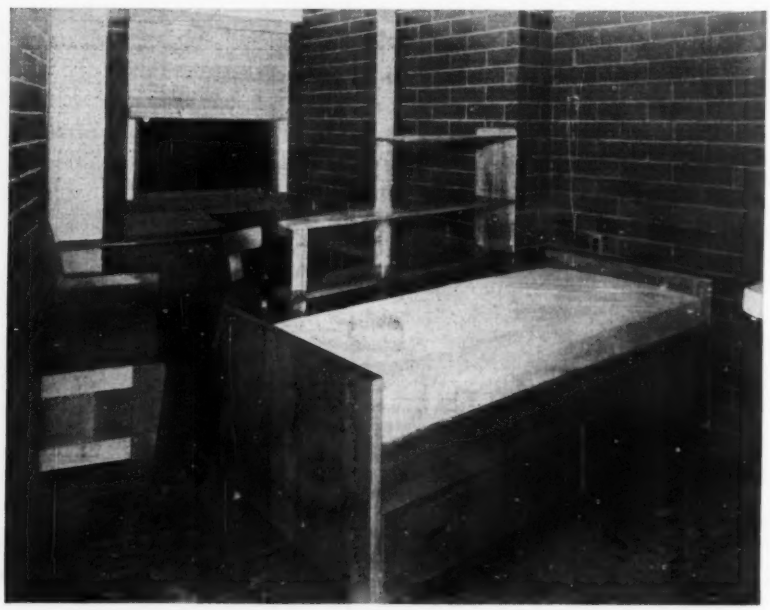
The matrix of American citizenship, in which the foregoing impurities shone out by their false brilliance, was sound, however. The United States was a nation of sturdy citizenry. Its mechanics and businessmen expected to get only what they earned, but as they viewed the tremendous store of the country's natural resources they were determined that their returns should be high. The 100-year-old democracy knew that it was immensely rich in minerals; that its industrial plant and transportation system were of vast value; that its soils and stands of timber offered wealth to those who should develop them.[5] It is of interest to review the steps whereby the American republic had risen to this high estate, during the cen-

[2] Advertisement in *Harper's Weekly*, 1873.

[3] Their delightfully plausible and ingenuously crooked hero, Colonel Beriah (also called Mulberry) Sellers, became the epitome of a promoter of shady ventures.

[4] *Harper's Weekly* called the peaceful setlement of this dangerous political crisis "The True Centennial Exposition."

[5] The Exhibition undoubtedly accelerated the recovery from the Panic of 1873, three years earlier, as the underlying factors of American financial strength, the country's resources, were there emphasized. Following the war, however, we were in a typical postwar period of low prices. As measured by the index of wholesale prices for all commodities, prices remained at low levels for nearly four decades after the Centennial, when the first World War caused a marked rise.



Manufacturers of Built-in Furniture for Senior House
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tury which the Exposition was to celebrate. Let us engage in such a review by visualizing how our grandfather might have regarded the first century of his nation's progress, while smoking his pipe and contemplating on life, more than seven decades back.

A Pragmatic Century

The smoker held his match, and his breath, until the choking fumes of the matches burned off. It was then safe to light cigar or pipe, and to meditate. Contemplatively, he could contrast the inconvenience of his grandfather's flint and steel with the easy utility of the friction match; a minor item in the long list of improvements which the team of progress – scientist, engineer, and industrialist – had given civilization in the century which had just ended. He had read inspiring accounts in the Centennial literature,[6] which had started with primitive beginnings and built up to the exalted state of American civilization which the Exhibition portrayed. Some of the more significant events in this story are shown in the table on page 512, in which events are listed decade by decade, in a way to reveal the accelerating pace at which American technology advanced.

The developments of this nation's first century pointed very definitely to unusual progress in many fields. In the educational field, one outstanding event in the story is worthy of specific emphasis, for its value in promoting American technological progress. On August 29, 1838, the packet, *Mediator*, sailed into New York Harbor from England, with the assets of the will of James Smithson, in the guardianship of Richard Rush. On behalf of the United States, Rush had entered friendly suit in the English Court of Chancery regarding the peculiar will of an Englishman who bequeathed to a country he had never seen, a substantial sum for education. The suit was settled in the unprecedently short time of two years in favor of the United States. Rush felt it wise to change the assets into gold sovereigns. Upon arrival in New York, Rush took the assets of Smithson's estate to the Philadelphia mint, and obtained a receipt for $508,318.46. Eight years later, after much debate, Congress accepted Smithson's gift to America, and the Smithsonian Institution for "the increase and diffusion of knowledge among men" was established. Thirty years later this famed institution played a significant role in Philadelphia. Smithsonian sent 21 carloads of exhibits to the Centennial; 42 carloads came back. This influx caused the construction of an additional Smithsonian building, now housing the Engineering and Industry Section.

Our smoker would undoubtedly ignore the early rumbles of the revolt against many social evils concomitant with the impressive growth of his country:

(*Continued on page 532*)

[6] *Harper's Weekly* and *Leslie's Illustrated Weekly*, prototypes of our present pictorial weeklies, devoted much space to the Centennial in 1876. Practically every issue of *Harper's* contained pages of woodcuts and text in that year.

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SIZES: B.I.W. Nylex lacing cord is made in 3 sizes as follows:

Size	*Breaking strength*	*Diameter*	*Yards per lb.*
#16	45 lbs.	.040"	900
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PUT UP on small 3 oz. spools convenient for lacing directly from the spools avoids waste and handling, and permits pulling tighter lacing and knots.

BOSTON INSULATED WIRE & CABLE CO.
Boston 25, Mass.

HIGH TIDE OF CONFIDENCE

(*Continued from page 531*)

the brutally long working hours for women and children; the exploitation of immigrant labor; the lack of regulation to restrain men like Gould and Fisk; the cruelly overloaded horses, that had led to the charter of the Society for the Prevention of Cruelty to Animals. 10 years before the Exposition opened its gates. To this meditative smoker of 1876, it had been a pragmatic century. The American system was good – it worked. It had made many men wealthy through their own hard work, initiative, and ability; it had evolved a leading nation in spite of its youth. Surely this Exposition, that would display the successes of the American system, would be a show worth attending.

Up-to-Date Construction in 1876

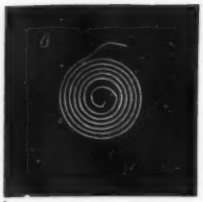
On one or another of the roads leading to the Exposition, the visitor endured his mud-mired hackney or carriage as an act of God cheerfully to be accepted. He would particularly appreciate the narrow-gauge railroad, which, for $0.05 would give him a 20-minute tour of the grounds. Visitors were advised, however, to make the "rapid tour" of the indoor avenues of the main buildings on foot, and should allow three days for the 25-mile walk. Even by today's standards, the Centennial exhibition was of large dimensions. There were 75 acres of buildings in the 236 acres of West Fairmount Park which was enclosed for the Exposition. The Main Exhibition Building exceeded one-third of a mile in length, and Machinery Hall was 1,402 feet long – more than a quarter of a mile.

It was a well-organized exhibition, which cost a $0.50 note to attend. For the convenience of the public, "rolling chairs" were available at $0.60 an hour, and many fountains dispensed soda water at $0.10 per glass. There were separate parlors for ladies and gentlemen, with barber shops to trim the bushy beards of the latter. There were carriage stands where one could check his buggy or farm wagon, telegraph service, messenger boys, and guides who spoke all languages.

Hideous architecture characterized most of the buildings, as might be expected in a period when architects revealed their aesthetic taste in city buildings with ponderous façades of cast iron or stone, and suburban mansions enlivened by disporting stags, or dogs, each in rigid cast-iron pose. Except for the granite Art Gallery, the structures of the Exposition faithfully portrayed the atrocious architectural styles of the period. That art could complement utility in the design of world's fair structures was a concept that was to await the Columbian Exposition at Chicago in 1893. Electric lights would then be available to emphasize, by night as well as by day, the beauty of the latter exposition, 16 years later.

Much timber construction was used in Philadelphia, not only because of the temporary nature of the structures, but because it was the practical solution for a substantial proportion of the bridges and buildings throughout the country. Substantial tonnages of wrought-iron shapes were used, however; the 672 iron

(*Continued on page 534*)



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HIGH TIDE OF CONFIDENCE

(*Continued from page 532*)

columns of the Main Building varied from 23 feet to 125 feet in length and weighed as much as 1,100 tons. It is probable that very little rolled steel was used, as steel shapes could still be called experimental; the Bessemer patent was but two decades old, and the first commercially successful open-hearth steel plant had started construction only seven years earlier.

A building contractor would note that "Portland cement, its uses exemplified," was listed in the catalog of exhibits, but he would find that such exhibits were limited. He would find that most of the building footings of the Exposition were of stone, and he would walk on vast areas of plank flooring, laid on the ground — an indication of the pioneer status of concrete construction. Tin ("the best roofing known in this climate") covered the 20-acre Main Building.

Engineering Contrasts

To the modern structural engineer, the woodcuts showing the construction of the huge buildings of the Exposition provide an interesting study. In the partly built Machinery Building, bearded men examine drawings (it was a little too early for blueprints), while, mostly by hand, heavy timbers are unloaded from trains of cars drawn by tiny steam locomotives. From the plank floor architects scan the wide-span roof trusses; the top chords are of wood, with wrought iron tension and compression members below. Challenging framing problems are suggested by the view of the all-wood, Gothic-arched trusses for the roof of Architectural Hall.

Striking demonstrations of hand labor are seen in the woodcuts. Twenty-six men carry a wood girder-truss to the Main Building; there are the double-yoked hand rollers, each with six men on either side alternately pulling them back and forth across a narrow road. A wood capstan raises a tall column, five men

(*Concluded on page 536*)

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HIGH TIDE OF CONFIDENCE

(*Concluded from page 534*)

pushing on either arm. Eight little foreign workmen tug at a multiroped hand-operated pile driver with weight hung from a timber tripod labeled with mysterious hieroglyphics. They are building the foundation of the Japanese building which later became so popular.

Occasionally, there is evidence of power-driven construction equipment. Fezzed Turkish commissioners superintend the unloading of a heavy crate from a flat car, on which is mounted a timber boom, powered by a diagonal-cylindered engine with vertical boiler. Progress over the ancient method of carrying large blocks of stone is also evidenced. As against the Appian-Way method, in which the stone was carried on slings hung from shoulder-borne poles, heavier stones were carried at the Exposition on a cleverly designed truck. The truck consisted of an overhead timber frame supporting two wooden drums with ratchets and pawls at their ends. Cables from the drums carried the stone. The underframe was a four-wheeled wagon, drawn by two horses.

The term "chrome engineering," used by an editor to voice his objection to so much garish paint and gold leaf, reveals the working leaven of the urge for the blending of art with utility in product design. America was progressing and future expositions would give less space to "horses, asses, and mules." Soon there would be no exhibits at all under such headings as "animal power machinery." An examination of the record of the actual exhibits is therefore worth our while, and will be undertaken in Part II of this article which will appear in the July issue of The Review. Of one thing we may be sure: hand-powered machinery was very definitely on the way out in the year 1876, when visitors from all parts of the world visited Philadelphia in celebration of the 100th birthday of the United States of America.

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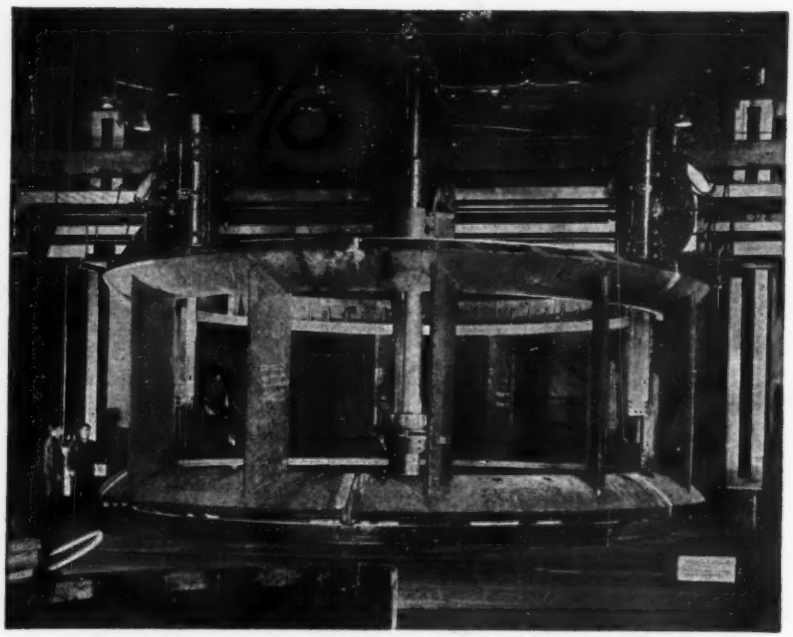
CARL MALMBERG



Machining speed ring for a 55,000 hp turbine on a 40' boring mill, one of the largest in the country. Many A-C machines and methods are unique because of the tremendous size of work pieces and wide variety of operations required in building the world's greatest range of industrial equipment.

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Welding stator yoke on 38,889 kva hydraulic turbine-driven generator.

One recent interesting project was the fabrication of stainless steel buckets for impulse-type hydraulic turbines to replace the old cast-type buckets. Working with design engineers and hydraulic engineers, our tank and plate specialists developed a design and method of manufacturing that produced buckets with several times the life of the old type.

Opportunities Everywhere

New developments in every department mean almost endless opportunities for young engineers. Right now, the erection shop is building a big crusher for processing taconite in the Mesabi range, and we are supplying most of the other ore processing equipment for this gigantic plant, too. At our Norwood plant, engineers have completely rebuilt the production system on motors and small pumps for greater efficiency and lower costs.

In fact, here at Allis-Chalmers there are big opportunities for young engineers in all phases of engineering work—design, research and development, manufacturing, sales and erection—in nearly any industry you can name. For Allis-Chalmers builds primary equipment for electric power . . . mining and ore processing . . . pulp and wood products . . . flour milling . . . steel . . . agriculture . . . public works . . . for *every* basic industry.

The thing that influenced me most when I left the University of Illinois to join Allis-Chalmers, was the tremendous breadth of opportunity. Some of my friends from that GTC class of 1930 are sales engineers now, some are design engineers, some have traveled around the world with erection crews. I chose manufacturing because I like to see things take shape before my eyes. I tried a good many things before I made my choice and my choice has been good.

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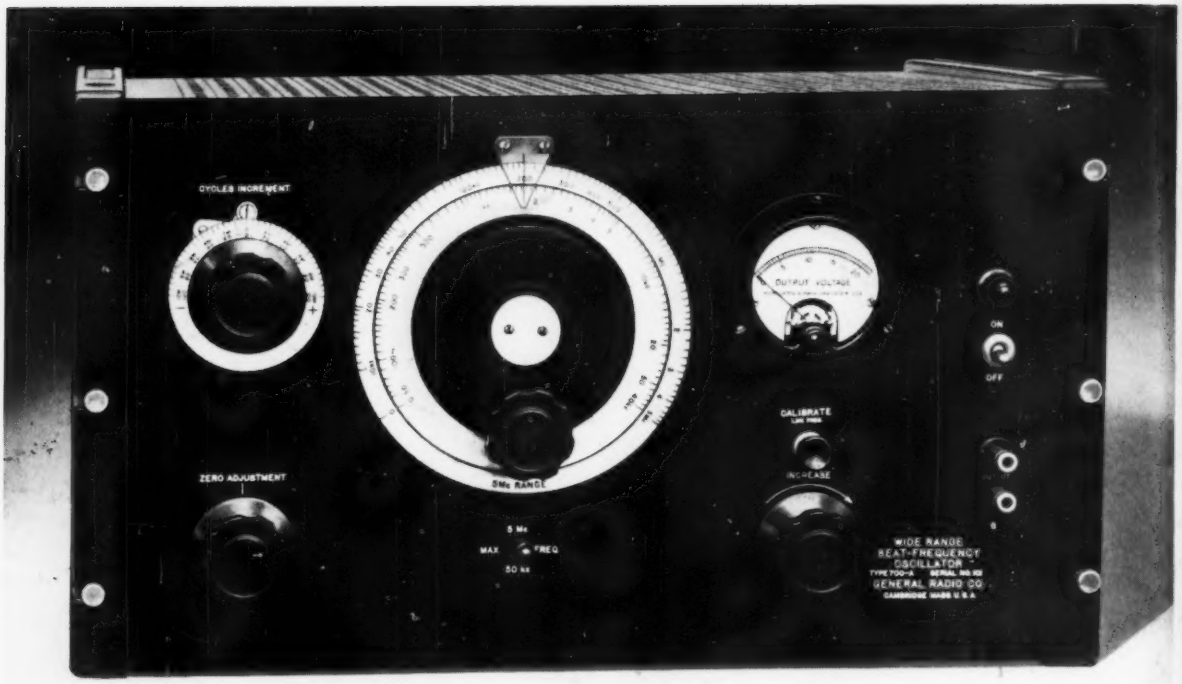

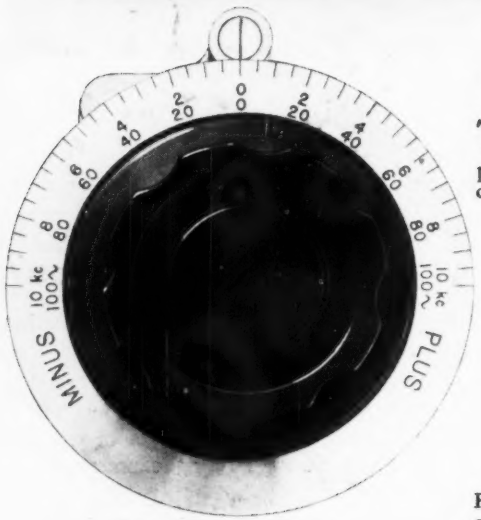

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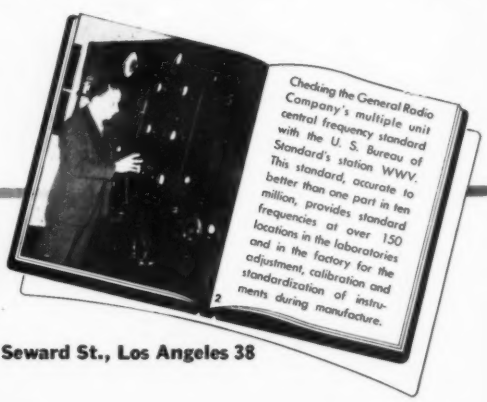
6. The output voltage is measured by a v-t voltmeter across the output terminals
7. Calibration may be standardized at any time to within 5 cycles and 500 cycles on the low and the high ranges, respectively

For taking selectivity curves on tuned circuits over a wide range of frequencies this oscillator is especially useful in that these measurements may be made very rapidly and accurately with this instrument.

TYPE 700—A WIDE-RANGE BEAT-FREQUENCY OSCILLATOR $700.00

WRITE FOR COMPLETE DATA


Checking the General Radio Company's multiple unit central frequency standard with the U. S. Bureau of Standard's station WWV. This standard, accurate to better than one part in ten million, provides standard frequencies at over 150 locations in the laboratories and in the factory for the adjustment, calibration and standardization of instruments during manufacture.
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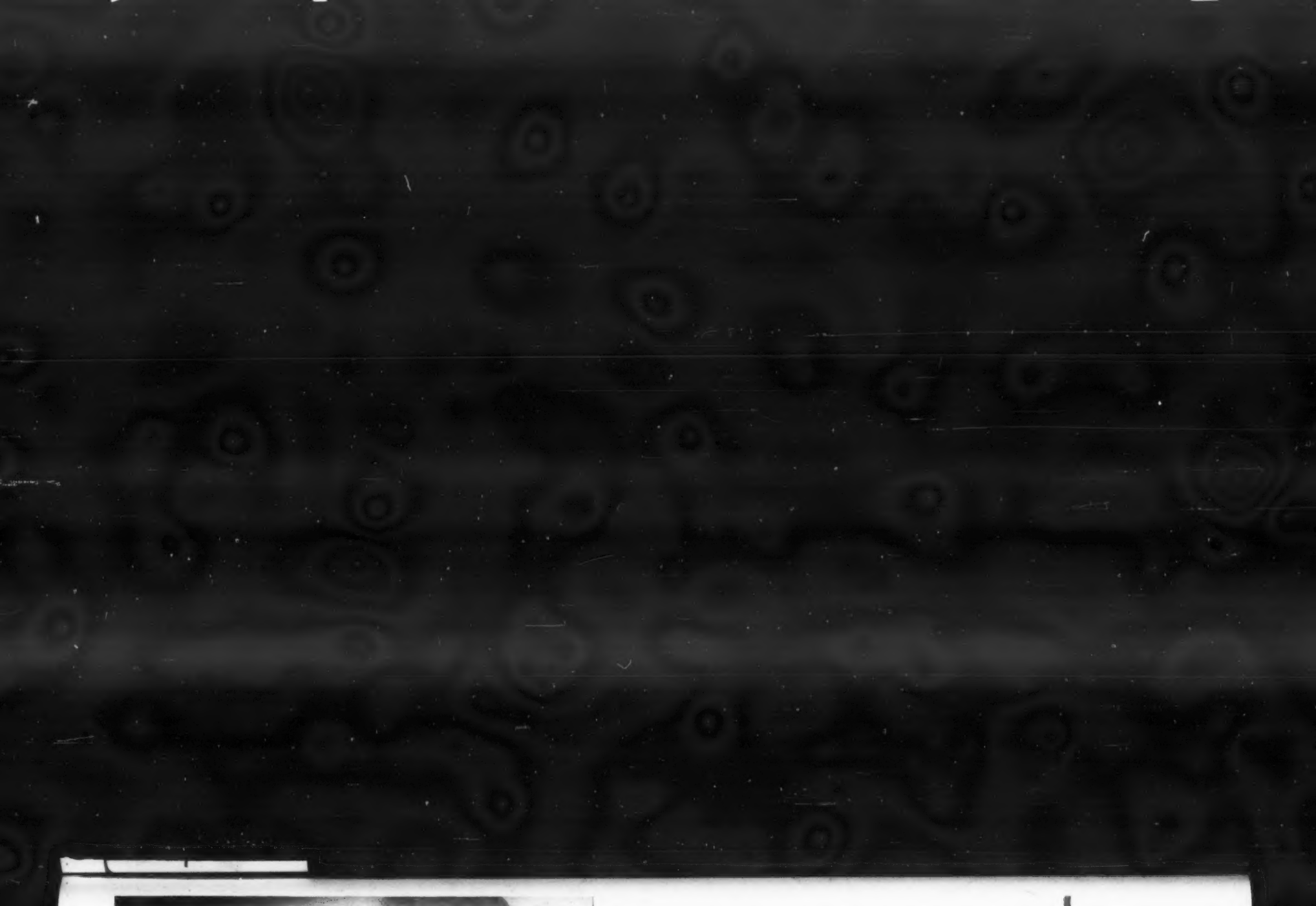
GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38